Sheobald, J. O. and others. The food of the rook, starling and ... 11...

A-T[heobald]
Rook Food
1916

HARVARD UNIVERSITY.

LIBRARY

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

47.301

GIFT OF

Samuel Henshaw.

November 1, 1917.

NOV 1 1917

SUPPLEMENT No. 15.

47.301

Supplement

TO

The Journal

OF THE

BOARD OF AGRICULTURE

MAY, 1916.

REPORTS

ON

THE FOOD OF THE ROOK, STARLING AND CHAFFINCH.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
BY JAS. TRUSCOTT & SON, LTD., SUFFOLK LANE, CANNON STREET, E.C.,
AND PUBLISHED BY THE BOARD OF AGRICULTURE AND FISHERIES

PRICE FOURPENCE.
POST FREE.

[FREE TO SUBSCRIBERS TO THE JOURNAL ON WRITTEN APPLICATION.]

[*All rights reserved.*]

NOV 1 1917

Supplement

TO

The Journal

OF THE

BOARD OF AGRICULTURE

SUPPLEMENT No. 15. MAY, 1916.

REPORTS

ON

THE FOOD OF THE ROOK, STARLING AND CHAFFINCH.

LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
BY JAS. TRUSCOTT & SON, LTD., SUFFOLK LANE, CANNON STREET, E.C.,
AND PUBLISHED BY THE BOARD OF AGRICULTURE AND FISHERIES.

SUPPLEMENTS TO THE JOURNAL OF THE BOARD OF AGRICULTURE.

No. 1.—Report on Agricultural Education in the United States .. .. Jan., 1908

No. 2.—The Food of Some British Birds .. Dec., 1908

No. 3.—Reports on the Work of the International Agricultural Institute April, 1910

No. 4.—Wheat: Papers Read at a Meeting of the British Association at Winnipeg, 1909 .. .. .. June, 1910

No. 5.—Influence on the Production of Mutton of Manures Applied to Pasture .. .. Jan., 1911

No. 6.—Report on the Work of the International Agricultural Institute July, 1911

No. 7.—The Interpretation of the Results of Agricultural Experiments .. Nov., 1911

No. 8.—Report on the Isle of Wight Bee Disease .. .. May, 1912

No. 9.—Notes on Kerry Woods, illustrating Methods of Collecting and Utilising Information for a Forest Survey .. .. Aug., 1912

No. 10.—Further Report on the Isle of Wight Bee Disease .. .. July, 1913

No. 11.—The Correlation between the Percentage of Milk Fat and the Quantity of Milk Produced by Ayrshire Cows .. .. .. Aug., 1913

No. 12.—Report on the Possibility of Reviving the Flax Industry in Great Britain .. .. .. Jan., 1914

No. 13.—Seed Control Stations on the Continent .. .. Aug., 1914

No. 14.—Report on the Poultry Industry in Wales .. .. Oct., 1915

ONE of the recommendations of the Departmental Committee appointed in 1903 to enquire into and report upon the existing condition of fruit culture in Great Britain was a proposal that the Board should establish a "bureau of information" dealing with matters connected with the fruit industry. In the Annual Report of the Intelligence Division of the Board for 1906 attention was drawn to the difficulty in carrying out this recommendation completely, but it was pointed out that an accurate enquiry into the habits and food of birds was much needed, especially into the assertions that these habits are undergoing a change in consequence of the changing conditions in which the wild life of England is placed, and it was determined, in order, as far as possible, to comply with the suggestions of the Committee, to begin with an enquiry on this subject. As a preliminary contribution, a report by Professor Newstead, dealing with the records which he had collected through a period of 20 years, and based upon 871 post-mortem examinations, was published as a Supplement to the *Journal*, and a proposal was under consideration for an extension of the work when, in the autumn of 1908, the British Association for the Advancement of Natural Science appointed a Committee to carry out investigations on the same subject, and the Board decided to work in conjunction with this body. The procedure adopted was to appeal to correspondents to send in specimens of birds recently shot, in order that the food contents of their crops might be examined and determined. The birds selected for this purpose were the rook, the starling and the chaffinch, as to whose character some doubt had been felt. The work of examining the birds was at first undertaken by Dr. Gordon Hewitt, and, after his appointment to the post of Entomologist to the Canadian Government, by Mr. H. S. Leigh, whose report is appended. The expenses of the enquiry were at first defrayed by a small grant from the British Association, supplemented by additional funds from the Board, but after the creation of the Development Fund a substantial grant was made by the Board out of the sum placed at their disposal for scientific research. For some time, all specimens of birds were sent to Mr. Leigh at Manchester, but during the latter part of the investigation an arrangement was made with Mr. F. V. Theobald, also a member of the Committee, who had been conducting some enquiries into the food of birds independently,

to divide England into two parts, one of which should be in the charge of Mr. Leigh and the other of Mr. Theobald, who has been assisted by Mr. W. McGowan. During the earlier part of the period, therefore, both investigators were receiving birds from all parts of England, while later on their specimens were mainly drawn from their respective districts. This explains, for the most part, why the majority of the birds reported upon by Mr. Leigh came from the northern counties of England and those dealt with by Mr. Theobald from the south. The methods adopted by each investigator have followed similar lines, but the work has been carried out independently. It is, therefore, interesting to note that the facts ascertained from the two investigations are in most respects very similar, but that in the case of one bird the conclusions drawn are very different. It is, perhaps, to be regretted that an agreement has not been reached in this case, and the divergence of views may lead to the opinion that the question has not been settled; but if this leads the reader to study the evidence and to draw his own conclusions from the facts laid before him it will probably be of advantage in the long run.

Board of Agriculture and Fisheries,
Whitehall Place, London, S.W.,
May, 1916.

CONTENTS.

PART I.—REPORT BY F. V. THEOBALD, M.A., F.E.S., ETC., AND WILLIAM MCGOWAN, F.S.I. PAGE.

SCOPE AND METHOD OF ENQUIRY 7
NUMBER OF SPECIMENS RECEIVED 8
ACKNOWLEDGMENTS 9

I. THE ROOK (*Corvus frugilegus*, Linn.)—

Number and Origin of Specimens received 9
Food of the Rook—
Grain—Injurious Insects—Mollusca—Other Insects—Weed-seeds 10
Nature of Food in 1912, month by month 10
Monthly Summary Table for 1912 12
Summary for 1912 12
Nature of Food in 1913, month by month 13
Monthly Summary Table for 1913 14
Summary for 1913 14
Nature of Food, January to May, 1914 15
Monthly Summary Table for 1914 15
Summary for 1914 16
Tables of Chief Insects eaten in each year 16
Tables of Grain, Harmful Seeds and Mollusca eaten in each year 18
Total Summary of Food 19
General Conclusions 19

II. THE STARLING (*Sturnus vulgaris*, Linn.)—

Number and Origin of Specimens received 20
Food of the Starling—
Grain—Insects—Mollusca—Weed-seeds 20
Nature of Food in 1912, month by month 21
Monthly Summary Table for 1912 25
Summary for 1912 25
Nature of Food in 1913, month by month 26
Monthly Summary Table for 1913 29
Summary for 1913 30
Nature of Food, January to May, 1914 30
Monthly Summary Table for 1914 32
Summary for 1914 32
Tables of Harmful Insects eaten in each year 32
Tables of Grain, Injurious Seeds and Mollusca eaten in each year 34
General Summary and Conclusions 35
Total Summary of Food 35
Note on Mollusca found in Starlings 35

III. THE CHAFFINCH (*Fringilla coelebs*, Linn.)—

Introduction 38
Number and Origin of Specimens received 38
Food of the Chaffinch—
Insects—Grain—Weed-seeds 39
Nature of Food in 1912, month by month 40
Monthly Summary Table for 1912 42
Summary for 1912 42
Nature of Food in 1913, month by month 43
Monthly Summary Table for 1913 44

Part I.—*continued.*

III. The Chaffinch (*Fringilla coelebs*, Linn.)—*continued*—

Food of the Chaffinch—*continued*— PAGE.

Summary for 1913 44
Nature of Food, January to May, 1914 45
Monthly Summary Table for 1914 46
Summary for 1914.. 46
Tables of Chief Insects eaten in 1912 and 1913 46
Tables of Grain, Harmful Seeds and Mollusca eaten in 1912 and 1913 47
General Summary and Conclusions 48
Total Summary of Food 49

Part II.—Report by H. S. Leigh, M.Sc.

Introduction 49
Scope and Method of Enquiry 50

I. The Food of the Rook—

Animal Food 51
Vegetable Food 51
Miscellaneous Food 52
Summary of Results 52

II. The Food of the Starling—

Animal Food 53
Vegetable Food 53
Miscellaneous Food 54
Summary of Results 54

III. The Food of the Chaffinch—

Animal Food 55
Vegetable Food 55
Summary of Results 55

REPORT ON THE FOOD FOUND IN THE ROOK, STARLING AND CHAFFINCH.

FRED. V. THEOBALD, M.A., F.E.S., ETC.

AND

WILLIAM MCGOWAN, F.S.I.

South-Eastern Agricultural College, Wye.

AN investigation and tabulation of the food contents of the rook, starling and chaffinch was undertaken by the writers in 1912 under a scheme drawn up by a special Committee of the British Association for the Advancement of Science, appointed in the autumn of 1908. This Committee, known as the "Economic Ornithological Committee," owed its inception to Dr. Gordon Hewitt, the present chief of the Dominion of Canada Entomological Department. Similar work has been carried out by Mr. H. S. Leigh, Secretary to the Committee, at the University of Manchester, whose report forms Part II. of this Supplement. This work has been carried out in co-operation with the Board of Agriculture and Fisheries, to whom the writers are greatly indebted, not only for help given in collecting specimens, but for having obtained for the Committee a grant of money from the Development Fund which has enabled them to complete this survey.

It has been found impossible to get correspondents to send in birds regularly in the numbers requested, and thus in a few cases no quite consecutive account of the food can be given.

Even if this had been done, however, it would have been difficult to ensure that the birds sent in had been feeding in the same locality where they were shot; starlings and rooks fly afar and those shot in any one locality may have been previously feeding many miles away. Some starlings shot at Wye, and at least two rooks, shot some years ago, contained marine organisms, and yet this village is situated 10 miles in

a straight line from the sea. Another unfortunate feature is the absence of records of the food of the nestlings, a very important point in deciding whether any particular bird is harmful or beneficial to the agriculturist and horticulturist, The results given in this report are merely a record of what the writers have found in the birds in question. The organisms have roughly been divided into harmful, beneficial, and neutral in the monthly tabular statements for each year.

How the proportion of these varies from time to time, even in a little over 2 years, can easily be seen from the tables. Few birds have been received from the coast districts and it may be taken generally that the food recorded is for inland localities. By analysing the food of the birds from certain districts nothing definite was found out. In fact it appears that much the same organisms are found in birds in all localities. For instance, the Raspberry Weevil (*Otiorhynchus picipes*) has been found in birds far from fruit-growing districts, and just as many Leather Jackets, Sitones, etc., have been found in birds from areas where fruit is prominent as from areas where little or no fruit is grown. In fact, certain food is taken by the birds, and this generally consists of widely-spread insects, seeds and other organisms.

An investigation of the food found in birds can only show part of what they eat, for such things as cherries (pulp only), spinach, turnip, cabbage and other leaves cannot always be identified satisfactorily, and large numbers of insects eaten by them are so damaged that identification is quite impossible. In the chaffinch many seeds that are eaten are shelled first and no one can safely say what they are. Some general ideas may, however, be gained. The opinions expressed in this report are based, not on the actual food of the birds, but on the *identifiable* organisms found in them.

It has been particularly difficult to get rooks sent in regularly. Some correspondents would not send them at all, as they considered them to be far too beneficial. It will be seen, however, from the tables giving the gizzard contents of the rooks examined that this statement is not by any means borne out, for the rook is thereby shown to be very harmful. On the other hand the starling has been shown to be most helpful. In regard to the chaffinch the writers do not feel entitled to express a definite opinion.

NUMBER OF SPECIMENS RECEIVED.—From January, 1912, to the end of May, 1914, 1,552 birds were received

and examined. The number of each of the 3 species was as follows :—

Rooks	277
Starlings	748
Chaffinches	527
	1,552

The birds were received from some 100 localities spread over 25 counties. Specimens were also received from Scotland (3 localities), Ireland (4), and Wales (1).

ACKNOWLEDGMENTS.—The writers must express their indebtedness to numerous correspondents, who have forwarded birds ; also to Mr. W. H. Britten, F.E.S., of the Hope Museum, Oxford, for naming the Coleoptera, to Mr Alfred E. Craven, of Haselmere, Ore, Hastings, for so kindly examining the Mollusca, and to Dr. Shipley, Master of Christ's College, Cambridge, for naming the Worms.

1.—THE ROOK (*Corvus frugilegus*, Linn.).

The exact economic status of the rook has for long been undecided. The results of this survey of its feeding habits point very decidedly to the rook being much more harmful than beneficial. It must, however, be clearly understood that, in this series of observations, no facts regarding the food of nestlings are recorded, or, as far as the writers are aware, have ever been systematically made. Fledged young have been examined by Newstead in Cheshire during May* ; these contained Noctuid larvæ, *Geotrupes*, Click Beetles, wheat, and pieces of potato tubers. More detailed facts on the food of nestlings are wanted, however, before these results are to be taken as definite.

The number of rooks received by the writers from January, 1912, to December, 1912, was 146 ; from January, 1913, to December, 1913, 92, and from January, 1914, to May, 1914, 39. Thus 277 rooks in all were received and opened, of which 9 were quite empty.

Specimens for examination were received from 53 localities representing 23 counties in England, as well as from 1 district in Wales, 2 in Scotland, and 2 in Ireland. Several have also been sent without any data, and have been examined and included in the results given here.

* *Journ. Bd. Agri.*, Supp. No. 9, p. 52, 1908.

FOOD OF THE ROOK.

The chief food of the rook, as far as this examination shows, is undoubtedly grain, for, in the 277 birds examined, no less than 5,872 wheat, barley and oat grains and useful seeds were found. On the other hand, 698 animal organisms were found; of these 654 were distinctly harmful.

The chief injurious insects eaten by the rooks were :—Wireworms, 188 in 146 birds in 1912; 1 in 92 birds in 1913, and 7 in 39 birds in 1914. Click Beetles, only 3 in 146 birds in 1912, 2 in 1913, and 5 in 1914, evidently but little taken. Leather Jackets numbered 15 in 1912, 59 in 1913, and 74 in the 39 birds up to May, 1914. Chafer larvæ only numbered 60 in the 277 birds and Surface larvæ 58.

The rook seems to eat comparatively few Mollusca, only 55 being found.

Amongst other insects found in the rooks' food were Hypera Weevils (*Hypera punctata*); Barynotus Weevils; some Dung Beetles, such as *Geotrupes* and *Aphodius*; a few earwigs; Dark Arches Moth larvæ; Swift Moth larvæ, and some Carabid larvæ. Now and then an earthworm occurred and occasionally a weed seed such as buttercup or bindweed. The majority of the Carabid larvæ are undoubtedly beneficial.†

NATURE OF FOOD, 1912.

The following list includes, month by month, the food found in 146 rooks examined from January, 1912, to December, 1912. There was also found much insect and vegetal debris that could not possibly be identified and tabulated.

In a few rooks strange articles were found, such as a bootlace, pieces of string, cloth, and even a nail.

JANUARY.—Four birds only received, all shot the same day at Wye. These contained only 7 insects, all being Wireworms, 27 Banded Snails (*Helicella caperata*) and 13 beans in fragments. Two birds also contained pieces of potato tubers and all contained red-brick fragments.

FEBRUARY.—During this month 32 birds were examined. These contained 27 Wireworms (*Agriotes hæmorrhoidalis*, *A. lineata*, etc.); 32 Surface larvæ‡ (*Agrotis exclamationis*); 3 Cockchafer larvæ (*Melolontha vulgaris*); 1 Carabid larva; 4 Dumble Dor Beetles (*Geotrupes stercorarius**); 1 Hypera Weevil (*Hypera punctata*); 12 Stratyomid larvæ; 2 Banded Snails (*Helicella caperata*); 3 Garden Snails (*Helix aspersa*); and 1 Wood Snail (*Helix nemoralis*); there were also 3 Earthworms (*Lumbricus terrestris**).

The following grains and seeds were also found :—Wheat, 40 grains; oats, 116; maize, 7; peas, 4. In 5 birds were 20 pieces of beans

* **This mark is used throughout the report to denote beneficial organisms.**

† A note is added concerning these larvæ under "The Starling" (p. 25).

‡ This insect has been unfortunately recorded here under three popular names—Surface Larvæ, Cut Worms (an American term), and as the larva of the Heart and Dart Moth.

(= 4 beans), and in 2, pieces of potato.† There were also 50 acorns, 1 seed of the black bindweed (*Polygonum Convolvulus*) and 1 seed of a buttercup (*Ranunculus*, sp.).

MARCH.—During this month 18 birds were examined. These contained :—16 Wireworms (*Agriotes* and *Athous*) ; 1 Click Beetle (*Agriotes lineatus*) ; 7 Chafer grubs (*Melolontha vulgaris*) ; 2 Dung Beetles (*Aphodius fimetarius*)* ; 3 Carabid larvæ (*Harpalus ruficornis*) ; 2 Hypera Weevils (*Hypera* sp. ?) ; 2 Yellow Underwing caterpillars (*Triphæna pronuba*) ; 20 Surface larvæ (*Agrotis exclamationis*) ; 6 Dark Arches Moth larvæ (*Xylophasia polyodon*) ; 6 Ants (*Formica fusca*) ; 2 Ants (*Myrmica ruginodis*, Nyl.) ; 2 Stratyomid larvæ ; 1 Centipede (*Geophilus longicornis*)*

Mollusca : 3 Hairy Snails (*Hygromia hispida*) ; 2 Banded Snails (*Helicella caperata*).

Thirty-one grains and husks of wheat ; 193 grains and husks of oats and 8 acorns.

APRIL.—Fifty-four birds examined. In these were found :—15 Leather Jackets (*Tipula oleracea*) ; 76 Wireworms (*Agriotes lineata*, *A. sputator* and *Athous hæmorrhoidalis*) and 2 Click Beetles (*Agriotes lineata*, Linn.) ; 27 Small Chafer larvæ (*Rhizotrogus solstitialis*) and 2 Cockchafer larvæ (*Melolontha vulgaris*) ; 3 Carabid larvæ (*H. ruficornis*) ; 7 Dung Beetles (*Geotrupes stercorarius*)* ; 10 Hypera Weevils (*Hypera punctata*) ; 1 Barynotus Weevil (*Barynotus elevatus*) ; 4 Surface larvæ (*Agrotis exclamationis*) ; 2 Therevid larvæ (*Thereva* sp. ?) ; 6 Muscid puparia.

Mollusca : 1 Wood Snail (*Helix nemoralis*) ; 2 Banded Snails (*Helicella caperata*).

Grain included 141 wheat, 372 oats, 2 maize grains and 5 peas. One bird contained 2 spurrey seeds (*Spergula arvensis*).

MAY.—Only 8 birds were received during this month. In these were found :—9 Chafer larvæ (*Rhizotrogus solstitialis*) and 1 adult Hypera Weevil (*Hypera punctata*) ; 1 Snail (*Helix cantiana*) ; 8 Earthworms (*Lumbricus*)* ; 6 wheat glumes and 10 oat husks.

JUNE.—Eight birds examined contained :—24 Wireworms (3 *A. lineata*, 20 *A. hæmorrhoidalis* and 1 sp. ?) ; 4 Dung Beetles (*Geotrupes stercorarius*)* ; 28 Noctuid larval skins, apparently *A. exclamationis* ; 64 grains and husks of wheat and 8 pieces of maize.

JULY.—Two birds examined contained :—7 Wireworms (*Agriotes lineata* and *A. sputator*) ; 2 Cockchafer grubs (*Melolontha vulgaris*) remains of Dung Beetle (*Geotrupes*)*. Remains of potato tuber, 7 oat husks and 3 pieces of acorn,

AUGUST AND SEPTEMBER.—None received.

OCTOBER.—Eleven birds examined. Most of these had empty gizzards or contained only grain and stones ; 2 Wireworms (*Agriotes*) ; 7 Cockchafer larvæ (*Melolontha vulgaris*) ; 2 Carabid larvæ ; 1 Wood Snail (*Helix nemoralis*), etc. ; 223 grains of wheat and 5 oat grains.

NOVEMBER.—Four birds were received. These contained :—28 Wireworms ; 2 Carabid larvæ ; 2 wheat grains ; 4 oats ; 33 barley grains ; 3 beans and 1 beech mast.

DECEMBER.—Five birds were examined. These contained :—1 Wireworm (*Agriotes*) ; 110 oats ; 5 grains of wheat and 20 beans.

† Not included in tables.

THE ROOK.

Monthly Summary, 1912.

Month.	Harmful Insects.	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Seeds.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain.	Neutrals.	Number of Birds.
January	7	0	0	0	27	0	0	0	0	0	0	13	0	4
February	64	0	0	0	6	2	4	0	0	3	0	221	12	32
March	65	0	0	0	5	0	2	0	1	0	0	232	2	18
April ..	148	0	0	0	3	2	7	0	0	0	0	520	0	54
May ..	10	0	0	0	1	0	0	0	0	8	0	16?	0	8
June ..	52	0	0	0	0	0	4	0	0	0	0	72	0	8
July ..	9	0	0	0	0	0	1	0	0	0	0	11	0	2
August ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—
September	—	—	—	—	—	—	—	—	—	—	—	—	—	—
October	11	0	0	0	1	0	0	0	0	0	0	228	0	11
November	30	0	0	0	0	0	0	0	0	0	0	43	0	4
December	1	0	0	0	0	0	0	0	0	0	0	135	0	5
Total	397	0	0	0	43	4	18	0	1	11	0	1491	14	146

SUMMARY, 1912.

From the table for this year it will be seen that, as regards the months in which birds were examined, the rook has been found to be doing much more harm than good in 7 months, and slightly more harm in 2 months. The only month in which rooks did slightly more good than harm was in January, and then only 4 birds were examined, all shot at the same place on the same day. All these had eaten a number of harmful mollusca.

The 146 birds examined were found to contain 1,491 grains and husks of corn, and also 18 beneficial insects, and 12 beneficial worms, myriapoda, etc.; but against these must be put 397 harmful insects, 43 harmful mollusca and 4 harmful plant seeds.

From February to April and October to December the food largely consisted of grain, but the rooks appeared to take it at all times in quantity except in May and July. From this year's record it appears that the rook is certainly much more harmful

as a grain destroyer than beneficial as an insect destroyer; nevertheless, it destroyed a considerable number of harmful insects and a few mollusca.

1913.

JANUARY.—Seven birds examined. In these there was no trace of any insect or animal food of any kind. They contained 103 grains of wheat and 19 of oats. Stones were found in 3 birds; roots in 1; grass in 1; moss in 1; twigs in 1; and pieces of newspaper in 1.

FEBRUARY.—Seven birds examined. These contained 3 Carabid larvæ* and the remains of 1 Snail (*Helix* sp. ?); also 230 wheat grains and husks; 7 oat grains and husks; 2 beans. They all contained stones and some pieces of root, grass or twigs. Two birds contained pieces of mangold.

MARCH.—Of the 28 birds examined, 1 was quite empty. The remaining 27 contained:—1 Wireworm; 3 Ground Beetles (*Steropus madidus*); 3 Earwigs (*Forficula auricularia*); 1 Carabid larva; 1 Weevil sp.?; 1 Noctuid pupa (*Agrotis*) †; 1 Dung Beetle (*Geotrupes*) †; 1 Millepede (*Julus* sp.); 2 Banded Snails (*Helicella caperata*); 2 Garden Snails (*Helix aspersa*). Much grain was found, including wheat, 192; oats, 256; barley and husks, 329; peas, 7; Indian corn, 2; beans, 2. Most of the birds also contained stones, chalk, brick, grit, and cinders; 1 contained bones, another pieces of egg shell, and, in several, moss, grass and decayed vegetal matter were found.

APRIL.—Fourteen birds were received and examined. In these were found 41 Leather Jackets (*Tipula oleracea*); 2 larvæ of the Dark Arches Moth (*Xylophasia polyodon*) and the remains of 1 Carabid Beetle (?). Four birds also contained much beetle debris.

The food again was chiefly in the form of grain, including 267 wheat husks; 70 whole wheat grains; 158 oat husks; 110 barley husks; 7 beans and 2 acorns. A mass of beetle debris was found in 1 bird. Stones, grit and chalk occurred in 7 birds, and pieces of root in 2.

MAY.—The 17 birds examined contained 18 Leather Jackets (*Tipula* sp.); 2 Click Beetles (*Agriotes sputator*); 8 Dark Arches Moth larvæ (*Xylophasia polyodon*); 2 Garden Swift Moth larvæ (*Hepialus lupulinus*); 3 Earwigs (*Forficula auricularia*). Fragments of at least 7 Millepedes (*Julus* sp.); 1 Centipede (*Geophilus longicornis*).* A single Earthworm (*Lumbricus*),* and 574 grains and husks of corn as follows:—120 wheat grains, 190 wheat husks; 50 barley grains; 42 oat grains, and 170 oat husks; 1 pea and 1 bean. Three birds contained much Coleopterous debris; 2 contained 10 unknown noctuid pupæ; 1, the head of a Lepidopterous larva, and 1 a piece of a Carabid; stones and grit were found in 8; cabbage leaves in 2; clover in 1 and grass in 1.

JUNE.—No birds received.

JULY.—In 3 birds examined there were 2 Chafer larvæ (*Melolontha vulgaris*) and 1 Banded Snail (*Helicella caperata*); also 240 oats and oat husks.

AUGUST.—No birds received.

† These two cannot be identified, being only fragments, and are not, therefore, included in the table.

SEPTEMBER.—The 4 birds sent did not contain any animal matter, but 14 wheat grains, 5 barley grains and 90 oats, also 1 acorn. Two birds contained much grit.

OCTOBER.—The 2 birds sent contained no animal matter at all, but 5 wheat grains and 72 oat husks; many stones and some brick and grit, etc., were found.

NOVEMBER.—Four birds were found to contain 11 whole oats, 115 oat husks and 1 an Earthworm (*Lumbricus*).*

DECEMBER.—The 6 birds examined this month contained no signs of any animal matter. Three were quite empty, the other 3 had 51 wheat grains and 14 oat husks in their crops.

THE ROOK.

Monthly Summary. 1913.†

Month.	Harmful Insects.	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Seeds.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain.	Neutrals.	Number of Birds.
January	0	0	0	0	0	0	0	0	0	0	0	122	0	7
February	0	0	0	0	1	0	3	0	0	0	0	239	0	7
March ..	9	0	1	0	4	0	0	0	0	0	0	788	0	28
April ..	44	0	0	0	0	0	0	0	0	0	0	614	0	14
May ..	33	0	7	0	0	0	0	0	1	1	0	574	0	17
June ..	–	–	–	–	–	–	–	–	–	–	–	–	–	–
July ..	2	0	0	0	1	0	0	0	0	0	0	240	0	3
August..	–	–	–	–	–	–	–	–	–	–	–	–	–	–
September	0	0	0	0	0	0	0	0	0	0	0	116	0	4
October	0	0	0	0	0	0	0	0	0	0	0	77	0	2
November	0	0	0	0	0	0	0	0	0	1	0	126	0	4
December	0	0	0	0	0	0	0	0	0	0	0	65	0	6
Total	88	0	8	0	6	0	3	0	1	2	0	2961	0	92

SUMMARY. 1913.

During the year January. 1913. to December. 1913. 92 birds were received; none of which came to hand in June and August. These were found to contain no less than 2,961 grains of wheat. oats. and barley, peas, beans, and Indian corn. whilst only 88 harmful insects. 8 harmful millepedes, and 6 mollusca were present. No animal matter at all was found from September to December. except one earthworm in November.

† The Earthworm is put with the Crustacea in these tables.

The rook was thus shown to be most harmful during the 10 of the 12 months, in which the birds were received. The actual amount of grain eaten was proportionally greater than in 1912, and the amount of animal matter much smaller. Only 6 mollusca were found in the 92 birds, against 43 in the 146 birds examined in the previous year.

1914.

JANUARY.—Three birds only received. These contained :—4 Wireworms ; 4 Leather Jackets (*Tipula oleracea*) ; 1 Chafer larva (*Melolontha vulgaris*) ; 2 Heart and Dart Moth larvæ (*Agrotis exclamationis*) ; 1 Millepede (*Julus* sp.) ; 3 Earthworms (*Lumbricus*),* and 48 grains of wheat. One bird contained some beetle debris, all 3 contained stones and 2 grass.

FEBRUARY.—Seven birds examined. They contained :—2 Leather Jackets (*Tipula oleracea*) ; 2 heads of Click Beetles ; 4 Dung Beetles (*Aphodius fimetarius*)*; 1 Earthworm (*Lumbricus*)*; also 18 whole oats, 274 oat husks and 42 barley husks.

MARCH.—Eighteen birds were found to have 583 grains and husks, etc., viz., 157 wheat, 385 barley, 22 whole oats and 10 oat husks ; 6 maize and 3 acorns. The insects present consisted of 33 Leather Jackets (*Tipula oleracea*) ; 3 Wireworms ; 7 Fever Fly larvæ (*Bibio hortulanus*) ; 1 Carabid larva (*Steropus madidus*). Pieces of turnip were found in 2 ; grass in 1 and grit in 5.

APRIL.—The 4 birds examined contained no grain, but 35 Leather Jackets (*Tipula oleracea*) ; 3 Click Beetles (*Agriotes sputator* and *Athous hæmorrhoidalis*) ; 4 Carabid larvæ (*Steropus madidus*) ; 6 Twist Snails (*Cochlicopa lubrica*).

One bird contained much decayed larval matter, and another pieces of bone.

MAY.—The 7 birds examined contained 200 grains of wheat, 200 of barley and 55 oat husks and oats ; also 5 larvæ and 4 pupæ of the Garden Swift Moth (*Hepialus lupulinus*), and 1 Millepede (*Julus* sp.).

THE ROOK.

Monthly Summary, 1914.

Month.	Harmful Insects.	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Seeds.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain, etc.	Neutrals.	Number of Birds.
January	11	0	1	0	0	0	0	0	0	3	0	48	0	3
February	4	0	0	0	0	0	4	0	0	1	0	334	0	7
March ..	44	0	0	0	0	0	0	0	0	0	0	583	0	18
April ..	42	0	0	0	0	0	0	0	0	0	0	0	6	4
May ..	9	0	1	0	0	0	0	0	0	0	0	455	0	7
Total	110	0	2	0	0	0	4	0	0	4	0	1420	6	39

SUMMARY, 1914.

In January, February, March, and May a large amount of grain was eaten by the 39 birds examined. On the other hand, in the 4 birds examined in April, 42 harmful insects were found, but no grain. During the other months comparatively little insect food was eaten. No mollusca were found at all, except 6 Twist Snails (neutral). Two harmful *Myriapoda*, and 4 beneficial insects were eaten, and 4 earthworms. It seems, therefore, that in 4 out of the 5 months the 39 birds were doing very much more harm than good, whilst in the fifth month (April) 4 birds were doing more good than harm.

THE ROOK.

Chief Insects Eaten.

1912.

Month.	Wire-worms.	Click Beetles.	Leather Jackets.	Chafers.	Surface Larvæ.	No. of Birds.
January	7	0	0	0	0	4
February ..	27	0	0	3	32	32
March	16	1	0	7	20	18
April	76	2	15	29	4	54
May	0	0	0	9	0	8
June	24	0	0	0	0	8
July	7	0	0	2	0	2
August	—	—	—	—	—	—
September ..	—	—	—	—	—	—
October ..	2	0	0	7	0	11
November ..	28	0	0	0	0	4
December ..	1	0	0	0	0	5
Total	188	3	15	57	56	146

1913.

Month.	Wire-worms.	Click Beetles.	Leather Jackets.	Chafers.	Surface Larvæ.	No. of Birds.
January	0	0	0	0	0	7
February ..	0	0	0	0	0	7
March	1	0	0	0	0	28
April	0	0	41	0	0	14
May	0	2	18	0	0	17
June	—	—	—	—	—	—
July	0	0	0	2	0	3
August	—	—	—	—	—	—
September ..	0	0	0	0	0	4
October ..	0	0	0	0	0	2
November ..	0	0	0	0	0	4
December ..	0	0	0	0	0	6
Total	1	2	59	2	0	92

1914.

Month.	Wire-worms.	Click Beetles.	Leather Jackets.	Chafers.	Surface Larvæ.	No. of Birds.
January	4	0	4	1	2	3
February ..	0	2	2	0	0	7
March	3	0	33	0	0	18
April	0	3	35	0	0	4
May	0	0	0	0	0	7
Total	7	5	74	1	2	39

Grain, Harmful Seeds, and Mollusca Eaten.

1912.

Month.	Grain and Seed.	Harmful Seeds.	Harmful Mollusca.	No. of Birds.
January	13	0	27	4
February	221	2	6	32
March	232	0	5	18
April	520	2	3	54
May	16	0	1	8
June	72	0	0	8
July	11	0	0	2
August	—	—	—	—
September	—	—	—	—
October	228	0	1	11
November	43	0	0	4
December	135	0	0	5
Total	1491	4	43	146

1913.

Month.	Grain and Seed.	Harmful Seeds.	Harmful Mollusca.	No. of Birds.
January	122	0	0	7
February	239	0	1	7
March	788	0	4	28
April	614	0	0	14
May	574	0	0	17
June	—	—	—	—
July	240	0	1	3
August	—	—	—	—
September	116	0	0	4
October	77	0	0	2
November	126	0	0	4
December	65	0	0	6
Total	2961	0	6	92

1914.

Month.	Grain and Seed.	Harmful Seeds.	Harmful Mollusca.	No. of Birds.
January	48	0	0	3
February	334	0	0	7
March	583	0	0	18
April	0	0	0	4
May	455	0	0	7
Total	1420	0	0	39

In the following summary are shown the relative numbers of harmful and beneficial organisms found in the rooks examined, together with the number of birds, for each period of the investigation :—

Total Summary of Food.

	Harmful Organisms.	*Beneficial Organisms.*	*No. of Birds.*
January to December, 1912	444 ..	1,521 ..	146
January to December, 1913	102 ..	2,967 ..	92
January to May, 1914 ..	112 ..	1,428 ..	39
	658 ..	5,916 ..	277

General Conclusions.

It is seen from the tables that the rook appears to be most harmful in destroying grain, whilst the amount of good it does as an insect destroyer is comparatively slight. It was only in May, 1912, and April, 1914, that it appeared to be doing any real good in proportion to its damage to grain. In fact, it may be concluded from this particular survey that the rook is a harmful bird, and that the opinion of the part it has been supposed to play as a destroyer of such insect pests as Leather Jackets, Wireworms, and Chafer grubs is not endorsed. How the rooks obtained wheat, etc., in some of the summer months was not found out.

II.—THE STARLING (*Sturnus vulgaris*, Linn.).

The specimens of starlings were received with much greater regularity than in the case of the rooks. No fewer than 748 birds were received and examined. Of these 52 were quite empty, leaving 696 whose food contents have been tabulated.

Specimens of starlings were received from 76 districts situated in 23 counties in England, and from 1 district in Wales, 3 in Scotland, and 4 in Ireland.

FOOD OF THE STARLING.

As in the case of the rook, no nestlings were examined, although from personal observations one of the writers feels sure that the major portion of the food of the young starlings is of insect nature. It will be seen from the tables that the starling's chief food was composed of injurious insects and allied creatures, except in November and, in one year, December, when grain practically equalled the insects and mollusca. Starlings, it seems, will always take grain, but only in such small quantities as almost to be a negligible factor. They seem to eat mollusca consistently, quite a number of small snails being found in a large proportion of the birds. Many of these mollusca, when present in numbers, are decidedly harmful. The chief insect food from January to May or June, and again from December to January, seems to be Leather Jackets.

The number of Wireworms found was small, except in February, March, and April. On the other hand, the starling appears to devour great numbers of Weevils, especially the Pea, Bean, Clover, and Tare *Sitones*, which were found in all months of the year except August, November and June. *Otiorhynchus* Weevils were found from February to May, and in July and August and, in one year, October and December. Weevils of the genus *Hypera* were found from January to August and October and December, and *Barynotus* Weevils from January to July. Some of the Lepidopterous larvæ of the Dark Arches Moth (*Xylophasia polyodon*), great numbers of Earwigs (*Forficula auricularia*), and various *Carabid* larvæ also seem to be eaten. Some of the latter are injurious, but most are beneficial. *Bibio* larvæ are also eaten, and starlings seem very partial to the small Dung Beetles (*Aphodius*). An occasional Chafer grub, Surface grub, Aphid, Swift Moth larva and pupa, as well as larvæ of

Muscid and Stratyomid flies were also found in them. The chief mollusca eaten consisted of the Hairy Snail (*Hygromia hispida*), the Banded Snail (*Helicella caperata* and *Helicella virgata*), the Strawberry Snail (*Hygromia rufescens*), all of which are harmful. Amongst neutral mollusca were found *Cochlicopa lubrica*, *Pyramidula rotundata*, *Vallonia pulchella*, *Vallonia nitidula* and an occasional harmful Grey Slug (*Agriolimax agrestis*). A few Centipedes and Millepedes, and occasionally an Earthworm or a Wood Louse may also occur.

The following weed seeds were found :—Spurrey (*Spergula arvensis*) ; Knotgrass (*Polygonum* sp.) ; Goosefoot (*Chenopodium* sp.) ; Sheep's Sorrel (*Rumex Acetosella*) ; Spear Thistle (*Carduus lanceolatus*) ; Buttercup (*Ranunculus* sp.) ; Bird's-Foot Trefoil (*Lotus corniculatus*), and Chickweed (*Stellaria media*).

Nature of Food, 1912.

The following list includes, month by month, the chief organisms found in the 392 starlings examined in 1912.

In addition to much grit, stones, etc., many of the birds contained quantities of vegetal and insect and other animal debris, which could not possibly be identified.

January.—The crops of the 6 birds sent in were all very full. Amongst insects were found 4 Leather Jackets (*Tipula oleracea*) ; 3 Wireworms (*Agriotes* sp.) ; 15 Click Beetles (*Agriotes sputator*) ; 2 Ground Beetle larvæ, apparently *Pterostichus* ;† 3 Pea and Bean Weevils (*Sitones lineata*) ; 4 larvæ of Muscid type ; 1 Noctuid larval skin, apparently the Turnip Moth (*Agrotis segetis*) ; 1 Leptid larva (*Leptis* sp. ?) ; 1 Staphylinid Beetle body ;* 1 Dung Beetle (*Aphodius*) ;* 16 Hairy Snails (*Hygromia hispida*) ; 14 Strawberry or Rufous Snails (*H. rufescens*) ; and the following neutral mollusca :—5 *Pyramidula rotundata* ; 14 *Vallonia pulchella* ; 5 *Vitrea radiata* ; 1 *Vertigo pygmæa*.

A small amount of grain was found, including 17 wheat husks, 2 whole wheat grains and 5 oat husks. In 2 birds there were some clover leaves ; in 1, pieces of a brome grass ; and in another, heads of the yellow trefoil ; and 4 contained beetle debris.

February.—Sixty birds were examined during this month. They contained 57 Leather Jackets (*Tipula oleracea* and *Tipula paludosa*) ; 13 Wireworms ; 2 Click Beetles (*Agriotes lineata*) ; 1 Surface larva (*Agrotis exclamationis*) ; 24 Muscid larvæ and 2 pupæ, probably *Hylemyia*) ; 31 Carabid larvæ (*Pterostichus*) ; 3 Pea and Bean Weevils (*Sitones lineata*) ; 10 Clover Weevils (*Sitones flavescens*) ; 2 *Sitones hispidula* ; 7 Hypera Weevils (*Hypera punctata*) ; 5 Raspberry Weevils (*Otiorhynchus picipes*) ; other beetles were *Largitarsus luridus*, Scop., and *Sciaphilus muricatus*, Fabr., 1 each. Earwigs (*Forficula auricularia*), 27 ; 1 Ladybird Beetle (*Adalia bipunctata*)* ; 3 Stratyomid larvæ ; 1 Centipede (*Geophilus longicornis*).*

† The larval *Pterostichus* have been taken as injurious when found in birds killed near strawberry land, and beneficial elsewhere.

No fewer than 148 Mollusca were present, including 54 Hairy Snails (*Hygromia hispida*) ; 20 Strawberry Snails (*H. rufescens*) ; 12 Banded Snails (*Helicella caperata*) ; the rest neutrals, including 4 *Pyramidula rotundata*, 29 *Vallonia pulchella* ; 25 *Cochlicopa lubrica* ; 1 *Clausilia laminata* ; and 3 *Azeca tridens*.

The following harmful seeds were found :—5 Spear Thistle (*Carduus lanceolatus*) ; 1 Spurrey (*Spergula arvensis*) ; 6 Knotgrass (*Polygonum* sp.) ; 3 Goosefoot (*Chenopodium*) ; 7 Mayweed (*Matricaria Chamomilla*) ; 3 Sheep's Sorrel (*Rumex Acetosella*) ; 2 Bird's-Foot Trefoil (*Lotus corniculatus*) ; 1 Buttercup (*Ranunculus bulbosus*) ; 1 Black Bindweed (*Polygonum Convolvulus*). Grain was represented by 170 grains and husks of wheat, 40 of oats and a single pea.

MARCH.—Forty-six starlings were sent in during this month and examined. The food was as follows :—175 Leather Jackets (95 were those of *Tipula oleracea*, 29 of *Tipula paludosa*, and 49 a species of *Pachyrrhina*, apparently *P. maculosa*) ; 40 Click Beetles (*Agriotes lineata* and *Athous hæmorrhoidalis* ; 70 Wireworms (*Agriotes*, etc.) ; 1 Muscid puparium ; 14 Carabid larvæ* ; 23 Clover Weevils (*Sitones flavescens*) ; 3 Pea and Bean Weevils (*Sitones lineata*) ; 8 Hypera Weevils (*Hypera punctata*) ; 10 Raspberry Weevils (*Otiorhynchus picipes*) ; 58 Barynotus Weevils (*Barynotus elevatus*) ; 1 Ground Beetle (*Harpalus ruficornis*) ; 2 other Carabids ? ; 1 Turnip Flea Beetle (*Phyllotreta undulata*) ; 13 Dung Beetles (*Aphodius fimetarius*)* ; 1 beetle *Philonthus politus*, Fabr. ; 35 Caterpillars of the Dark Arches Moth (*Xylophasia polyodon*) ; 6 Ants, 3 being *Lasius flavus* and 3 *Formica rufa* ; 55 Earwigs (*Forficula auricularia*) ; 12 Rove Beetles or Staphylinidæ* ; 1 Centipede (*Geophilus longicornis*).*

The following species of Mollusca were present :—10 Strawberry or Rufous Snails (*Hygromia rufescens*) ; 34 Hairy Snails (*Hygromia hispida*) ; 9 Down Snails (*Helicella virgata*) ; 11 *Pyramidula rotundata* ; 9 *Vertigo pygmæa* and 3 Twist Snails (*Cochlicopa lubrica*), the last 3 species being neutrals. A few seeds were found ; amongst these there were only 9 of harmful species, 5 being Thistle (*Carduus lanceolatus*) ; 3 Sheep's Sorrel (*Rumex Acetosella*) and 1 of Bird's-Foot Trefoil (*Lotus corniculatus*).

Wheat seeds and husks to the number of 98 were found in 6 birds only ; oats 79 in 4 birds. Amongst other things found were the perianth of the rush, grass, scraps of roots, stones, and much coleopterous debris in 3 birds.

APRIL.—Ninety-nine birds examined. These contained :—215 Leather Jackets (167 being *T. oleracea*, Linn., 2 *T. paludosa*, Mg., and 46 *T. lateralis* ? Mg.) ; 7 Click Beetles (*Agriotes* and *Athous*) ; 32 Wireworms ; 2 Muscid larvæ ? ; 36 Clover Weevils (*Sitones flavescens*, Marsh) and 4 *Sitones hispidula*, Fabr. ; 4 Hypera Weevils (*Hypera punctata*) ; 115 Raspberry Weevils (*Otiorhynchus picipes*, Fabr.) ; 3 Barynotus Weevils (*Barynotus obscurus*) ; 8 Staphylinids* ; 1 *Xanthobium longiventris* ; 2 Ground Beetles (*Steropus madidus*, Fabr., and *Harpalus ruficornis*, Fabr.) ; 2 Turnip Flea Beetles (*Phyllotreta undulata*) ; 13 Dung Beetles (*Aphodius fimetarius*, *granaria* and *fossor*)* ; 1 Therevid larva ; 7 Dark Arches Moth larvæ (*Xylophasia polyodon*, Linn.) ; 107 Earwigs (*Forficula auricularia*) and remnants of 2 flies. Millepedes (*Julus londinensis*), 3 ; Spiders,* 4.

Seventy-five Mollusca :—25 Hairy Snails (*Hygromia hispida*, Linn) ; 6 Strawberry Snails (*H. rufescens*, Pennant) ; 5 Down Snails (*Helicella virgata*, da Costa) ; 3 *Pyramidula rotundata* ; 29 *Vallonia* sp. ; 4 *Cochlicopa lubrica*, Müller ; and 3 *Vertigo pygmæa*. Also 4 Periwinkles (*Littorina litoræa*) with seaweed and a small crab's leg.

No weed seeds were found, but 81 grains of wheat in 7 birds and 18 oats in 3 birds. Grass was found in 15 birds, bits of roots in 9, perianths of rushes in 4, much decayed vegetal matter in 2, a quantity of beetle debris in 5, chitin fragments in 1, and debris of beetle larvæ in 1.

MAY.—Eighty-two birds examined. In these were found :—94 Leather Jackets (75 of *T. oleracea* and 19 of *T. paludosa*) ; 35 Click Beetles (34 *Agriotes lineata* and 1 *Athous* sp. ?) ; 10 Wireworms ; 2 Dark Arches Moth caterpillars (*Xylophasia polyodon*) ; 8 Carabid larvæ (*Pterostichus*) ; 2 Clover Weevils (*Sitones flavescens*) and 1 *Sitones* sp. ? ; 12 Hypera Weevils (*Hypera punctata*) ; 6 Barynotus Weevils (*Barynotus elevatus*) ; 5 Raspberry Weevils (*Otiorhynchus picipes*) ; 16 *Otiorhynchus tenebricosus;* 1 Ground Beetle (*Steropus madidus*) ; 1 Dung Beetle (*Geotrupes stercorarius*)* ; 1 Rove Beetle (*Staphylinid*) ? * 2 Sciarid larvæ ; 3 Fever Fly Larvæ (*Bibio* sp.) ; 1 Caddis Worm ; 1 wing of Crane Fly (*Tipula* sp.) ; 3 Lepidopterous larval skins ; 6 Millepedes (*Julus*) ; 1 Centipede (*Geophilus longicornis*)* ; 1 Spider skin* ; 1 Wood Louse (*Oniscus ascellus*) ; amongst the Mollusca were 20 Hairy Snails (*Hygromia hispida*), 9 Strawberry Snails (*H. rufescens*), 2 Banded Down Snails (*Helicella caperata*) and 1 *H. virgata*, 1 *Helicella cantiana*, 1 *Azeca tridens*. One bird contained 2 Black Bindweed seeds (*Polygonum*) and 1 Chickweed seed (*Stellaria media*).

In 11 of the birds 62 grains and husks of wheat were found. Nine contained grass, 3 moss, 2 pieces of bread, 3 pieces of roots, 1 flint chips, and 16 much Coleopterous debris.

Thus the 82 birds examined in May were found to contain 245 harmful organisms, and 66 beneficial ones, leaving a balance of 189 on the right side.

JUNE.—Forty-five birds were sent in. These contained :—25 Leather Jackets (17 of *Tipula oleracea* and 8 *Pachyrrhina* sp. ?) ; 4 Wireworms and 1 Click Beetle (*Agriotes lineatus*) ; 1 Hypera Weevil (*Hypera punctata*) ; 1 Barynotus Weevil (*Barynotus elevatus*) ; 10 adult Dung Beetles (*Aphodius* sp. ?)* ; 1 Rove Beetle (*Staphylinid*)* ; 22 Carabid larvæ,* apparently *Pterostichus* ; 1 Larva of the Dark Arches Moth (*Xylophasia polyodon*) ; 5 larvæ of the Mottled Umber Moth (*Hybernia defoliaria*) ; 1 Tortrix larva (*Tortrix* sp. ?) ; 3 Lepidopterous larvæ skins ? ; 2 Stratyomid larvæ (*Sargus* sp. ?) ; 5 Ants (*Formica fusca*) ; 43 Earwigs (*Forficula auricularia*) ; 1 Snake Millepede (*Julus londinensis*) ; 1 Spider* ; 1 Wood Louse (*Oniscus ascellus*).

In 4 birds were found 13 grains of wheat, and in 7 birds remains of about 14 green cherries.

Miscellaneous matter found included grass in 7, leaves in 1, and much fragmentary beetle debris in 2. Thus these 45 birds contained 94 harmful organisms and 34 beneficial ones, excluding grain, mostly husks, leaving a balance of 60 harmful insects, etc.

JULY.—In this month only 17 birds were sent in, and these contained very little in their crops, some being almost empty ; in them were found 5 Leather Jackets (*Tipula oleracea*, Linn.) ; 4 Wireworms ; 4 Raspberry

Weevils (*Otiorhynchus picipes*, Fabr.); elytra of 6 Aphodius beetles*; 1 Leptid larva (*Leptus* sp. ?); 1 Cabbage Moth (*Mamestra brassicæ*, Linn.); 5 Clover Weevils (*Sitones flavescens*, Marsh); 3 Hypera Weevils (*Hypera punctata*); 4 Rove Beetles (*Staphylinidæ*)*; 2 Spiders*; 37 Mollusca including 12 Hairy Snails (*Hygromia hispida*), 4 Strawberry Snails (*H. rufescens*), 18 *Vallonia pulchella*, 3 *Cochlicopa lubrica*; and the following seeds:—2 Wild Oats (*Avena* sp.); 1 cherry stone; 1 oat; grass was found in 9 birds; pieces of leaves and moss in 2, and roots in 1.

AUGUST.—Seven birds in which were found the following:—2 Leather Jackets (*Tipula oleracea*, Linn.); 7 Wireworms; 3 Carabid Beetles (*Pterostichus*); 9 Raspberry Weevils (*Otiorhynchus picipes*. Fabr.); remains of 5 Weevils (*Otiorhynchus* sp. ?); 7 Barynotus Weevils (*Barynotus obscurus*); 7 Dung Beetles (*Aphodius contaminatus*)*; 3 Rove Beetles (*Staphylinidæ*)*; 29 small Cabbage Moth (*Mamestra brassicæ*) larvæ; 3 Yellow Underwing (*Triphæna pronuba*) larvæ; 1 Ground Beetle (*Harpalus ruficornis*); 1 Frog Hopper (*Typhlocyba* sp.); 1 Muscid wing; 2 Spiders*; 1 Banded Snail (*Helicella caperata*); 2 Centipedes (*Geophilus longicornis*)*; in 1 bird some grit. No trace of seed or corn was found.

SEPTEMBER.—Only 1 starling sent in; this contained 3 Pea Weevils (*Sitones lineata*, Linn.); 6 Ants (*Lasius flavus*, Nyl.); 3 oats and 1 wild oat.

OCTOBER.—Six birds, containing 6 Wireworms; 4 Carabid larvæ (*Harpalus*); 4 Clover Weevils (*Sitones* sp. ?); 3 Hypera Weevils (*Hypera punctata*); 7 Dung Beetles (*Aphodius punctato sulcatus*, Sturm),* and the following Mollusca:—20 Strawberry Snails (*Hygromia rufescens*); 24 Hairy Snails (*Hygromia hispida*); 11 Banded Snails (*Helicella caperata*); 4 Twist Snails (*Cochlicopa lubrica*); and 2 *Vallonia pulchella*. The birds contained 50 grains of oats. Grass was found in 3; wood shavings in 1; and decayed vegetation in 1.

NOVEMBER.—Fourteen birds examined, which contained 17 Leather Jackets (*Tipula oleracea*); 2 Carabid larvæ*; 73 Earwigs (*Forficula auricularia*); 21 Dipterous larvæ (*Muscids*); 12 Dung Beetles (*Aphodius fimetarius*)*; 7 Hairy Snails (*Hygromia hispida*); 2 Strawberry Snails (*H. rufescens*); 35 *Pyramidula rotundata*; 12 *Cochlicopa lubrica*.

115 grains of barley and 4 of oats were also found. Much beetle debris was present in 5, grain in 5, moss in 1, stones in 1, stems and twigs in 2.

DECEMBER.—Nine birds examined. These contained:—14 Leather Jackets (*Tipula oleracea*); 14 Wireworms; 5 Hypera Weevils (*Hypera punctata*); 1 Pea Weevil (*Sitones lineata* ?); 1 Click Beetle (*Agriotes lineatus*); 4 larval St. Marks Fly (*Bibio Marci*); 3 Muscid larvæ; 13 Dung Beetles (*Aphodius fimetarius*)*; 7 Stratyomid larvæ; 71 Mollusca, including 35 Hairy Snails (*Hygromia hispida*), 14 Strawberry Snails (*Hygromia rufescens*), 2 *Vitrea nitidula*, 4 Banded Snails (*Helicella caperata*), 2 *Vallonia pulchella*, 4 *Pyramidula rotundata*, and 10 *Cochlicopa lubrica*.

A single, nearly whole, Earthworm* (*Lumbricus terrestris*) was found, and 5 grains of wheat, 74 of oats and 1 of barley. Grass was found in 2 birds, and an apple pip and pulp in another.

THE STARLING.

Monthly Summary, 1912.

Month.	Harmful Insects.*	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Seeds.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain.	Neutrals.	Number of Birds.
January	32	0	0	0	30	0	2	0	0	0	0	24	26	6
February	186	0	0	0	86	29	1	0	1	0	0	211	65	60
March ..	489	0	0	0	53	9	39	0	1	0	0	177	23	46
April ..	536	0	3	0	36	0	21	1	0	0	0	99	43	99
May ..	202	0	6	1	33	3	2	1	1	0	0	62	1	82
June ..	92	0	1	1	0	0	33	1	0	0	0	27	2	45
July ..	23	0	0	0	16	2	10	2	0	0	0	2†	21	17
August..	68	0	0	0	1	0	10	2	2	0	0	0	0	7
September	9	0	0	0	0	1	0	0	0	0	0	3	0	1
October	17	0	0	0	55	0	7	0	0	0	0	50	6	6
November	111	0	0	0	9	0	14	0	0	0	0	119	47	14
December	42	0	0	0	55	0	13	0	0	1	0	80	23	9
Total	1807	0	10	2	374	44	152	10	5	1	0	854	257	392

SUMMARY, 1912.

From the foregoing table it will be seen that, from January to October, the starlings examined had devoured much more animal food than grain and seed, that in November the amount of grain and beneficial insects eaten was rather larger than the number of harmful organisms, while in December slightly more good than harm was done.

The birds appeared to be doing most good from February to June and again in August and September; in October also more good than harm appeared to be done. In March the 46 birds examined were found to contain 489 harmful insects, 53 harmful mollusca and 9 harmful seeds, against 177 grains of corn and 40 beneficial insects, etc. The number of Leather Jackets eaten from February to May was large. For the whole

* Carabid larvæ of the groups *Harpalus*, *Zabrus* and *Steropus* are included here. Very many Carabidæ, both larvæ and adults, are beneficial, and these have been placed amongst the Beneficials. Sorauer says "Some Carabids are phytophagus in both adult and larval stages, especially species of Amarus, Zabrus and Harpalus, and such beetles are easily recognised in both adult and larval stages by their shorter, broader, and more blunt mandibles." (Handbuch der Pflanzenkrankheiten, 3, p. 462 (1913).)

† 1 cherry-stone included,

year 392 birds had devoured 608 of these harmful larvæ and 264 Wireworms and Click Beetles in their single meals. During the same period they had eaten 854 grains of wheat, barley and oats, and 374 harmful mollusca. Collectively they had destroyed 2,237 harmful Arthropods, other animals and plant seeds and only 1,022 beneficial organisms. Thus, speaking generally, we may say that the starlings were actively beneficial for at least 10 months out of the 12 in 1912.

1913.

JANUARY.—Twenty-two birds were received. These contained the following :—12 Leather Jackets (*Tipula oleracea*) ; 1 Wireworm (*Agriotes*) ; 2 Carabid larval skins (*Harpalus ?*) ; 3 Ground Beetles (*Harpalus ruficornis*) ; 8 Pea and Bean Weevils (*Sitones lineata*) ; 1 Barynotus Weevil (*Barynotus obscurus*) ; 1 Flea Beetle (*Phyllotreta undulata*) ; 13 Dung Beetles (*Aphodius* sp., wing cases)* ; 1 Hypera Weevil (*Hypera punctata*) ; 2 Rove Beetles (*Staphylinidæ*)* ; 1 beetle (*Bembidium obtusum*, Sturm)† ; 2 Dark Arches Moth larvæ (*Xylophasia polyodon*) ; 2 Stratyomid larvæ (*Pachygaster* sp.) ; 2 Stratyomid larvæ (*Sargus* sp.), and 25 other Stratyomid larvæ ; 2 Leptid larvæ (*Leptus* sp. ?) ; 11 Muscid type larvæ (*Hylemyia* sp. ?) ; 1 Dipterous puparium ; 6 Noctuid larvæ (*? Agrotis segetis*) ; 1 Lepidopterous pupa ; 1 Dipteron wing sp. ? ; 3 Earwigs (*Forficula auricularia*) ; 1 Brown Scale (*Lecanium capreæ*) ; 1 Millepede (*Julus* sp. ?) ; 4 Centipedes (*Geophilus longicornis*)* ; 8 Spiders* ; 1 Wood Louse (*Oniscus ascellus*) ; 52 Mollusca (33 injurious), including 13 Hairy Snails (*Hygromia hispida*), 7 Strawberry Snails (*Hygromia rufescens*), 10 Banded Snails (*Helicella caperata*), 3 *Pyramidula rotundata*, 5 *Vallonia pulchella*, and 3 *Vallonia nitidula* (the last 3 species being neutrals) ; 6 Twist Snails (*Cochlicopa lubrica*), 2 Snails (*Vertigo* sp. ?), and 3 Slug's eggs. In all 17 oats were found and 4 barley grains. Grass was found in 6 birds. In 1 was some straw, in another decayed vegetal matter ; Crow's Foot leaves were found in 1, and beetle debris, which was unidentifiable, in 7.

One bird shot at Wye contained 4 shells of the Periwinkle (*Littorina litoræa*), a small crab's leg, and pieces of seaweed with Polyzoa. This bird must have been feeding some miles away on the sea shore.

FEBRUARY.—The number of birds received was 59, three of which were quite empty. The rest contained the following insects, etc. :—82 Leather Jackets (*Tipula oleracea*) ; 33 Wireworms (*Agriotes*) ; 14 Click Beetles (*Agriotes lineata* and *A. sputator*) ; 12 Carabid larvæ* ; 10 Pea and Bean Weevils (*Sitones lineata*) ; 28 Clover Weevils (*Sitones flavescens*) ; 6 Hispid Weevils (*Sitones hispidula*) ; 2 *Sitones sulcifrons* ; 9 Hypera Weevils (*Hypera punctata* 6 ; *H. nigrirostris*, Linn. 2 ; *H. plantaginis*, De Geer. 1) ; 3 Barynotus Weevils (*Barynotus obscurus*) ; 1 Cockchafer grub (*Melolontha vulgaris*) ; 1 Ground Beetle (*Pterostichus cupreus*, Linn.)* ; 14 Dung Beetles (9 *Aphodius* sp. ? ; 3 *A. fossor*, Linn. ; 1 *A. punctato sulcatus*, Sturm. ; 1 *A. granarius*)* ; also specimens of the following beetles :—1 *Philonthus varius*, Gyll.† ; 1 *Stenus fassalis*, Linn. ; 2 *Rhinoncus pericarpius*, Linn.† ; 2 *Helophorus aquaticus*, Linn.† ; 3 *Lathrobium fulvipenne*, Linn.† ; 1 *Tachyporus hypnorum*, Fabr.† ; 1 *Ocypus cupreus*, Rossi.* ; 1 *Chrysomella staphylea*, Linn.† ; 1 *Quedius rufipes*, Grav.* ; 1 *Q. fustis*,

† These are probably harmful species.

Grav.* ; 1 *Q. boops*, Grav.* ; 1 *Tropiphorus tomentosus*, Marsh† ; 1 *Strohposomus faber*, Herbst† ; 1 Raspberry Weevil (*Otiorhynchus picipes*, Fabr.)† ; 1 *Ptinus fur*† ; 1 *Niptus hololeucus*† ; 1 *Trachyphlœus aristatus*, Fabr. ; 1 *Amara apricaria*, Sturm.† ; and the following dipterous larvæ :—6 Stratyomids (*Pachygaster*) ; 17 (*Sargus*) ; 4 other *Stratyomids*, 86 Fever Fly larvæ, including 32 St. Mark's Fly larvæ (*Bibio Marci*) ; 1 Therevid larva (*Thereva* sp. ?) ; 1 Fungus Gnat larva (*Sciara* sp. ?) ; 5 Muscid larvæ and puparia of *Homalomyia* and *Calliphora* ; 1 *Limnobia* sp. ? Also 1 Dark Arches Moth larva (*Xylophasia polyodon*) ; 1 Garden Swift Moth larva (*Hepialus lupulinus*) ; 2 Ants (*Myrmica ruginodis* and *M. lævinodis*) ; 1 Brown Scale (*Lecanium persicæ*) ; 24 Earwigs (*Forficula auricularia*) ; 6 Spiders* ; 6 Millepedes (*Julus* sp.). Also the following Mollusca :—104 Banded Snails (*Helicella caperata*) ; 1 Down Snail (*H. virgata*) ; 65 Hairy Snails (*Hygromia hispida*) ; 60 Strawberry Snails (*Hygromia rufescens*) ; 2 Wood Snails (*Helix nemoralis*) ; and the following neutrals :—30 *Vallonia pulchella* ; 67 *Vitrea nitidula* ; 38 *Cochlicopa lubrica* ; 12 *Azeca tridens* ; 4 *Clausilia radiata* ; and 20 immature *Helix*, probably *hispida* and *rufescens*. A single Earthworm* was also found and 11 grains of corn.

Thirteen birds contained grass and twigs ; 2 buds and 18 unidentifiable beetle and larval debris.

MARCH.—Forty-nine birds were examined. These contained :—200 Leather Jackets, mostly *Tipula oleracea* and a few *T. paludosa* ; 11 Wireworms ; 14 Click Beetles (*Agriotes sputator* and *A. lineata*) ; 72 Carabid larvæ* ; 1 Cutworm or Surface larva (*Agrotis exclamationis*) ; 6 larvæ of the Dark Arches Moth (*Xylophasia polyodon*) ; 15 Clover Weevils (*Sitones flavescens*) ; 6 Hypera Weevils (*Hypera punctata*) ; 32 Dung Beetles (*Aphodius contaminatus* and *A. fimetarius*)* ; 5 Stratyomid larvæ ; 1 Therevid larva (*Thereva* sp. ?) ; 6 Ants ; 2 Fever Fly larvæ (*Bibio* sp. ?) ; 1 Devil's Coach Horse (*Ocypus olens*)* ; 1 Raspberry Weevil (*Otiorhynchus picipes*) ; 1 Earwig (*Forficula auricularia*) ; and 2 Muscid puparia. Also 6 Spiders* and 4 Centipedes (*Geophilus longicornis*).* Of Mollusca there were 8 Strawberry Snails (*Hygromia rufescens*) ; 17 Hairy Snails (*Hygromia hispida*) ; 16 Banded Snails (*Helicella caperata*) ; 4 Twist Snails (*Cochlicopa lubrica*) ; and 4 Trident Snails (*Azeca tridens*). Of grain, 34 oat husks and 13 wheat grains.

Moss, grass and roots were present in 15 ; stones, etc., in 10, and beetle debris in 13.

APRIL.—Twenty-nine birds were examined, the contents being as follows :—11 Leather Jackets (*Tipula oleracea* and *paludosa*), 39 Click Beetles (*Agriotes sputator* 35, and *Agriotes lineata* 4) ; 15 Wireworms ; 44 Carabid larvæ (*Steropus*) ; 6 Clover Weevils (*Sitones flavescens*) ; 1 Pea and Bean Weevil (*Sitones lineata*) ; 2 Sitones sp. ? ; 27 Dung Beetles (*Aphodius fimetarius*)* ; 1 Devil's Coach Horse (*Ocypus olens*)* ; 1 Raspberry Weevil (*Otiorhynchus picipes*) ; 2 Dark Arches Moth (*Xylophasia polyodon*) larvæ ; 6 Ants (*Myrmica ruginodis*) ; 2 Fever Fly larvæ(*Bibio* sp.) ; 1 Mycetid ? ; 1 Earwig (*Forficula auricularia*), and 14 Noctuid pupæ. Millepedes (*Julus* sp.) 4 ; 1 Centipede (*Geophilus longicornis*).* Of Mollusca there were 81 Banded Snails (*Helicella caperata*) ; 1 Down Snail (*H. virgata* and 1 Strawberry Snail (*Hygromia rufescens*). Much beetle debris occurred in 5 birds, moss in 1 and leaves in 1.

MAY.—Twenty-nine birds examined ; they contained :—56 Leather Jackets (*Tipula oleracea* and *T. paludosa*) ; 27 Click Beetles (*Agriotes*

† These are probably harmful species.

sputator, *A. lineata* and *Athous hæmorrhoidalis*) ; 2 Wireworms ; 6 Ground Beetles (*Steropus madidus*) ; 6 Carabid larval skins* ; 3 Pea and Bean Weevils (*Sitones lineata*) ; 7 Clover Weevils (*S. flavescens*) ; 2 Weevils (*Sitones* sp. ?) ; 3 Hypera Weevils (*Hypera punctata*) ; 1 Raspberry Weevil (*Otiorhynchus picipes*) ; 4 Dung Beetles (*Aphodius fimetarius*)* ; 1 Chafer larva ; 1 Devil's Coach Horse (*Ocypus olens*)* ; 5 Staphylinid beetle bodies* ; 11 Dark Arches Moth (*Xylophasia polyodon*) larvæ ; 1 Stratyomid larva ; 2 Millepedes (*Julus londinensis*) ; 17 Banded Down Snails (*Helicella caperata*) ; 4 Down Snails (*H. virgata*) ; 1 Wood Snail (*Helix nemoralis*) ; 11 Vallonia Snails (*Vallonia pulchella*) ; 1 Twist Snail (*Cochlicopa lubrica*) ; and 1 Earthworm.* Much beetle debris occurred in 15, grass in 2, other vegetal matter in 3, and stones in 1.

JUNE.—Of the 5 birds received not one contained any food.

JULY.—The 16 birds examined contained :—3 Leather Jackets (*Tipula* sp.) ; 1 Daddy Long Legs (*Tipula* sp. ?) ; 15 Pea and Bean Weevils (*Sitones lineata*) ; 3 Clover Weevils (*Sitones flavescens*) ; 2 Weevils (*Sitones* sp. ?) ; 6 Ground Beetles (*Steropus madidus*) ; 2 Carabid larval skins ; 1 Barynotus Weevil (*Barynotus obscurus*) ; 1 Hypera Weevil (*Hypera punctata*) ; 20 Noctuid larval skins ; 3 Muscid larvæ (*Anthomyia* ?) ; 1 Earwig (*Forficula auricularia*) ; 2 Millepedes (*Julus*) ; 1 Hairy Snail (*Hygromia hispida*) ; 13 Banded Snails (*Helicella caperata*) and 1 Down Snail (*H. virgata*) ; 1 Twist Snail (*Cochlicopa lubrica*).

Much beetle debris in 5, clover leaves in 1. Two birds were quite empty.

AUGUST.—Five birds examined ; they contained :—4 Hypera Weevils (*Hypera punctata*) ; 12 Chafer larvæ (*Rhizotrogus solstitialis*) ; 2 Ghost Moth larvæ (*Hepialus humuli*) ; 1 young Dark Arches Moth (*Xylophasia polyodon*) larva ; 5 Daddy Long Legs (*Tipula* sp. ?)† ; 1 Muscid puparium ; 4 Twist Snails (*Cochlicopa lubrica*).

SEPTEMBER.—Ten birds examined ; they contained :—20 Daddy Long Legs (*Tipula oleracea*, *paludosa* and *lateralis*) ; over 900 Tipulid ova (judging from the number left after counting up to 900 there were probably 1,500 in 8 of the birds) ; 2 Clover Weevils (*Sitones flavescens*) ; 1 Allied Pea and Bean Weevil (*Sitones crinitus*) ; 2 Earwigs (*Forficula auricularia*) ; 27 Noctuid Moth larval skins ; 3 Earthworms.* Two birds were quite empty, and 2 contained beetle debris.

OCTOBER.—Thirty-one birds examined ; these contained :—5 Leather Jackets ; 6 Click Beetles (*A. sputator*, 2 ; *A. hæmorrhoidalis*, 4) ; 12 Wireworms ; 90 Pea and Bean Weevils (*Sitones lineata*) ; 35 Clover Weevils (*Sitones flavescens*) ; 1 *Sitones hispidulus*, Fabr. ; 1 *Sitones puncticollis*, Steph. ; 4 *Sitones* sp. ? ; 3 Hypera Weevils (*Hypera punctata*) and 1 *Hypera plantaginis*, De Geer ; 21 Dung Beetles (*Aphodius*)* ; 17 Carabid larvæ* ; 1 *Anthonomus* sp. ? (head) ; 2 *Strophosomus faber*, Herbst.; 1 *Simplocaria semistriatus*, Fabr. ; 3 *Xantholinus linearis*, Ol. ; 2 Ghost Moth (*Hepialus humuli*) larvæ ; 1 Garden Swift Moth (*H. lupulinus*) larva ; 1 Dark Arches Moth (*Xylophasia polyodon*) larva ; 14 Muscid larvæ and pupæ ; 3 Fever Fly larvæ (*Bibionidæ*) ; 4 Earwigs (*Forficula auricularia*) ; 2 Rove Beetles (*Staphylinidæ*)* ; 2 Woodlice (*Oniscus ascellus*) ; 32 Banded Down Snails (*Helicella caperata*) and 2 Hairy Snails (*Hygromia hispida*) ; 1 *Cochlicopa lubrica*, and 1 Earthworm (*Lumbricus terrestris*).*

† These cannot be placed, and are included in table as neutrals.

One bird contained 2 grains of wheat, and others 21 barley grains and husks. Much beetle debris in 9 and Lepidopterous larval remains in 7. Two birds were empty.

NOVEMBER.—Only 2 birds were sent in. These contained :— 2 Click Beetles (*Athous hæmorrhoidalis*) ; 6 Wireworms ; 2 Banded Snails (*Helicella caperata*) ; 1 Earthworm* ; 25 grains of wheat.

DECEMBER.—Fourteen birds examined, 7 of which were quite empty. The other 7 contained :—32 Leather Jackets (*Tipula oleracea*, etc.) ; 21 Wireworms ; 30 Click Beetles (*A. sputator* and *A. hæmorrhoidalis*) ; 32 Pea and Bean Weevils (*Sitones lineata*) ; 7 Clover Weevils (*S. flavescens*) ; 2 Raspberry Weevils (*Otiorhynchus picipes*) ; 2 Hypera Weevils (*Hypera punctata*) ; 1 Ground Beetle (*Pterostichus* sp.) ; 13 Ground Beetle larvæ (*Carabidæ*)* ; 75 Fever Fly larvæ (*Bibionidæ*) ; 22 Muscid larvæ ; 2 Sargus larvæ†; 26 Noctuid larval skins (*Agrotis* sp.) ; 12 Earwigs (*Forficula auricularia*) ; 6 Aphides (*Rhopalosiphum persicæ*) ; 12 Small Snake Millepedes (*Blanjulus pulchellus*) ; 2 Millepedes (*Julus* sp.) ; 13 Woodlice (*Oniscus ascellus*, 7 ; and *Armadillidium vulgare*, 6).

Twenty-four mollusca, 2 being whole Field Slugs (*Agriolimax agrestis*) ; 20 Banded Snails (*Helicella caperata*) ; 2 Down Snails (*Helicella virgata*). Also 2 Earthworms (*Lumbricus terrestris*).*

Of grain, 29 wheat, 6 barley, also 3 beech mast and 20 charlock seeds. Much vegetal debris in 4 birds, and beetle debris in 2.

THE STARLING.

Monthly Summary, 1913.

Month.	Harmful Insects.	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Seeds.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain.	Neutrals.	Number of Birds.
January	56	0	1	1	33	0	15	8	4	0	0	21	50	22
February	329	0	6	0	232	0	31	6	0	1	0	11	198	59
March ..	266	0	0	0	41	0	105	6	4	0	0	47	13	49
April ..	144	0	4	0	83	0	28	0	1	0	0	0	1	29
May ..	119	0	2	0	22	0	16	0	0	1	0	0	13	29
June ..	0	0	0	0	0	0	0	0	0	0	0	0	0	5
July ..	58	0	2	0	15	0	0	0	0	0	0	0	1	16
August..	20	0	0	0	0	0	0	0	0	0	0	0	9	5
September	952	0	0	0	0	0	0	0	0	3	0	0	0	10
October	190	0	0	2	34	0	40	0	0	1	0	23	1	31
November	8	0	0	0	2	0	0	0	0	1	0	25	0	2
December	268	0	14	13	24	20	13	0	0	2	0	38	0	14
Total	2410	0	29	16	486	20	248	20	9	9	0	165	286	271

† It is uncertain whether these are beneficial or neutral, and they are not included in the table.

SUMMARY, 1913.

It will be seen from the table that, as in the preceding year, the starling was doing far more good than harm in all months of the year except in November, when 2 birds were found to have eaten 25 grains of wheat and only 10 harmful animals. In the previous year this bird was doing slightly more harm than good from October to December if the amount of grain eaten be compared with the harmful arthropods alone, but when the number of harmful mollusca are added to the harmful arthropoda the positions are reversed in October and December, and equalised in November. One may say, therefore, that in 1912 the starling was doing more good than harm during at least 10 months out of the 12. The same applies in some measure to 1913, but more marked harm was done by devouring grain in November and more pronounced good in December. The sudden rise recorded in September up to 95 harmful insects per bird is, perhaps, not normal, as a large number of Tipulid eggs found in the birds were counted as separate organisms.

Unfortunately all 5 birds examined in June were quite empty. November and December were the only months when any quantity of grain was found, whilst in 1912 much was found in October, November, and December, although in October and December more good was done than harm.

A PARASITIC WORM FOUND IN THE STARLING.—Several parasitic worms were found in the gizzard of the starling in 1912 and 1913, as isolated specimens. Dr. Shipley has examined these on behalf of the writers and names them *Ascaris ensicaudata*. Specimens were obtained in January, April, June and September.

1914.

JANUARY.—Four birds examined. In these were found :—49 Leather Jackets (*Tipula oleracea, T. paludosa* and *T. lateralis*) ; 2 Wireworms (*Agriotes*) ; 6 Click Beetles (*Agriotes sputator*, 4 ; *Athous hæmorrhoidalis*, 2) ; 24 Clover Weevils (*Sitones flavescens*) ; 2 Weevils (*Sitones* sp. ?) ; 5 Carabid larval skins* ; 2 Hypera Weevils (*Hypera punctata*) ; 3 Muscid larvæ (*Calliphora*) ; 2 Stratyomid larvæ ; 1 Hairy Snail (*Hygromia hispida*). No trace of grain was found, but 1 grass seed and 1 seed each of Spurrey (*Spergula arvensis*) and Knotgrass (*Polygonum aviculare*). Three of the birds contained much unidentifiable beetle debris, and in 1 were found bits of roots.

FEBRUARY.—Thirty-one birds examined. In these occurred :—87 Leather Jackets (*Tipula oleracea*) ; 9 Wireworms ; 9 Click Beetles (*A. sputator* and *A. hæmorrhoidalis*) ; 17 Pea and Bean Weevils (*Sitones*

lineata) ; 17 Clover Weevils (*Sitones flavescens*) and 37 possible Pea Weevils (*Sitones* sp. ?) ; 5 Carabid larvæ* ; 3 Hypera Weevils (*Hypera punctata*) ; 3 Barynotus Weevils (*Barynotus elevatus*) ; 7 Dung Beetles (*Aphodius fimetarius*)* and 1 *Aphodius punctato sulcatus** ; 3 Dark Arches Moth (*Xylophasia polyodon*) larvæ ; 7 Noctuid larvæ ; 12 Stratyomid larvæ ; 14 Muscid larvæ (*Hylemyia* ?) ; 2 Millepedes (*Julus*) ; 2 Spiders* ; 1 Grey Field Slug (*Agriolimax agrestis*); 45 Banded Snails (*Helicella caperata*) ; 2 Down Snails (*H. virgata*) ; 4 Hairy Snails (*Hygromia hispida*) ; 3 *Vallonia pulchella* ; 28 *Cochlicopa lubrica* ; 57 *Pyramidula rotundata*. Also 2 oats, 2 seeds of Sheep's Sorrel (*Rumex Acetosella*) and 2 of Knotgrass (*Polygonum aviculare*). Eight birds contained much beetle debris, while 4 contained grass and vegetal matter.

MARCH.—Nineteen birds examined. These contained :—67 Leather Jackets (*T. oleracea*) ; 19 Click Beetles (*A. lineata* 11, *A. sputator* 3, *A. hæmorrhoidalis* 5) ; 7 Wireworms ; 4 Hypera Weevils (*Hypera punctata*) ; 3 Carabid larvæ (*Harpalus*) ; 2 Carabid heads ? ; 1 Stratyomid larva ; 3 Dung Beetles (*Clavinia fossor* 2, and *Aphodius* 1)* ; 1 *Philanthus lucens*, E.* ; 1 *Quedius semaeneus*, Steph.* ; 2 *Xanthobinus linearis*, Ol. ; 2 Fever Fly larvæ (*Bibio* sp.) ; 1 Surface larva (*Agrotis exclamationis*) ; 1 Sitones sp. ? ; 3 Muscid larvæ ; 3 Millepedes (*Julus*) ; 3 Spiders* ; 18 Banded Snails (*Helicella caperata*) ; 6 *Cochlicopa lubrica* ; 1 seed of Spurrey (*Spergula arvensis*) and 7 oat husks. Ten birds contained grass, roots and decayed vegetal matter, 9 beetle debris, and 1 the skin of a Noctuid Moth larva.

APRIL.—Six birds examined. These contained :—18 Leather Jackets (*Tipula* sp.) ; 6 Click Beetles (*A. sputator*) ; 1 Hypera Weevil (*Hypera* sp. ?) ; 2 Ground Beetles (*Steropus madidus*) ; 1 Dark Arches Moth (*Xylophasia polyodon*) larva ; 1 Carabid larval skin* ; 1 Strawberry Snail (*Hygromia rufescens*); beetle debris occurred in 4 birds.

MAY.—Twenty-five birds were examined. These were, in some cases, very full of insects, including much debris. One was empty. There were :—80 Leather Jackets (*Tipula oleracea*) ; 47 Wireworms ; 29 Click Beetles, mostly *A. sputator*, and *A. hæmorrhoidalis* ; 26 Carabid larvæ* ; 1 Ground Beetle (*Harpalus ruficornis*) ; 4 Raspberry Weevils (*Otiorhynchus picipes*) ; 1 Vine Weevil (*Otiorhynchus sulcatus*); 8 Hypera Weevils (*Hypera punctata*) ; 7 Grass Beetles (*Dasycera cervina*) ; 1 Lady Bird (*Adalia bipunctata*)* ; 1 Dung Beetle (*Aphodius fimetarius*)* ; 1 Staphylinid* ; 9 Fever Fly larvæ (*Bibionidæ*) ; 2 Stratyomid larvæ ; 4 Garden Swift Moth (*Hepialus lupulinus*) pupæ ; 1 Spider* ; 4 Banded Snails (*Helicella caperata*) ; 1 Down Snail (*H. virgata*) ; 1 Flesh Fly (*Sarcophaga carnaria*).

Two grains of wheat and 8 oat husks were found, and in 2 birds Muscid wings, probably *Sarcophaga carnaria*, occurred, and Lepidopterous larval remains in 3.

THE STARLING.

Monthly Summary, 1914.

Month.	Harmful Insects.	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Seeds.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain.	Neutrals.	Number of Birds.
January	88	0	0	0	1	2	5	0	0	0	0	1	2	4
February	206	0	2	0	52	4	13	2	0	0	0	2	100	31
March ..	109	0	3	0	18	1	5	3	0	0	0	7	7	19
April ..	28	0	0	0	1	0	1	0	0	0	0	0	0	6
May ..	190	0	0	0	5	0	29	1	0	0	0	10	3	25
Total	621	0	5	0	77	7	53	6	0	0	0	20	112	85

SUMMARY, 1914.

Only 5 months are recorded here. During all the time the birds were doing much more good than harm. The marked rise in January is continued from the December of the previous year, and is very different from the level seen in January of the 2 previous years.

THE STARLING.

Chief Harmful Insects Eaten.

1912.

Month.	Leather Jackets.	Click Beetles.	Wire-worms.	Carabid larvæ.	Sitones.	Hypera.	Otio-rhynchus.	Xylophasia.	Bibio.	Earwigs.	No. of Birds.
January	4	15	3	2	3	0	0	0	0	0	6
February	57	2	13	31	15	7	5	0	0	27	60
March	175	40	70	0	26	8	10	35	0	55	46
April	215	7	32	0	40	4	115	7	0	107	99
May	94	35	10	8	3	12	21	2	3	0	82
June	25	1	4	0	0	1	0	1	0	43	45
July	5	0	4	0	5	3	4	0	0	0	17
August	2	0	7	3	0	0	14	0	0	0	7
September	0	0	0	0	3	0	0	0	0	0	1
October	0	0	6	4	4	3	0	0	0	0	6
November ..	17	0	0	0	0	0	0	0	0	73	14
December	14	1	14	0	1	5	0	0	4	0	9
Total ..	608	101	163	48	100	43	169	45	7	305	392

1913.

Month.	Leather Jackets.	Click Beetles.	Wire-worms.	Carabid larvæ.	Sitones.	Hypera.	Otio-rhynchus.	Xylophasia.	Bibio.	Earwigs.	No. of Birds.
January	12	0	1	2	8	1	0	2	0	3	22
February	82	14	33	0	46	9	1	1	86	24	59
March	200	14	11	0	15	6	1	6	2	1	49
April	11	39	15	44	9	0	1	2	2	1	29
May	56	27	2	0	12	3	1	11	0	0	29
June	0	0	0	0	0	0	0	0	0	0	5
July	3	0	0	2	20	1	0	0	0	1	16
August	0	0	0	0	0	4	0	1	0	0	5
September	0	0	0	0	3	0	0	0	0	2	10
October	5	6	12	0	131	4	0	1	3	4	31
November ..	0	2	6	0	0	0	0	0	0	0	2
December	32	30	21	0	39	2	2	0	75	12	14
Total ..	401	132	101	48	283	30	6	24	168	48	271

1914.

Month.	Leather Jackets.	Click Beetles.	Wire-worms.	Carabid larvæ.	Sitones.	Hypera.	Otio-rhynchus.	Xylophasia.	Bibio.	Earwigs.	No. of Birds.
January	49	6	2	0	26	2	0	0	0	0	4
February	87	9	9	0	71	3	0	3	0	0	31
March	67	19	7	3	1	4	0	0	2	0	19
April	18	6	0	0	0	1	0	1	0	0	6
May	80	29	47	0	0	8	5	0	9	0	25
Total ..	301	69	65	3	98	18	5	4	11	0	85

Grain, Injurious Seeds and Mollusca Eaten.

1912.

Month.	Grain.	Injurious Seeds.	Harmful Mollusca.	No. of Birds.
January	24	0	30	6
February	211	29	86	60
March	177	9	53	46
April	99	0	36	99
May	62	3	33	82
June	27	0	0	45
July	2	2	16	17
August	0	0	1	7
September	3	1	0	1
October	50	0	55	6
November	119	0	9	14
December	80	0	55	9
Total	854	44	374	392

1913.

Month.	Grain.	Injurious Seeds.	Harmful Mollusca.	No. of Birds.
January	21	0	33	22
February	11	0	232	59
March	47	0	41	49
April	0	0	83	29
May	0	0	22	29
June	0	0	0	5
July	0	0	15	16
August	0	0	0	5
September	0	0	0	10
October	23	0	34	31
November	25	0	2	2
December	38	20	24	14
Total	165	20	486	271

1914.

Month.	Grain.	Injurious Seeds.	Harmful Mollusca.	No. of Birds.
January	1	2	1	4
February	2	4	52	31
March	7	1	18	19
April	0	0	1	6
May	10	0	5	25
Total	20	7	77	85

General Summary and Conclusions.

Taking the whole time from January, 1912, to May, 1914, it will be seen that the starling devoured many more harmful organisms than beneficial, and it was only in October, November and December that any quantity of grain was eaten and even in those months more harmful organisms were eaten than grain and other beneficial material with the exception of November, 1913, and to a slight extent in December, 1912. Much more good was done in 1913 and 1914 than in 1912. Undoubtedly starlings are most beneficial on account of the great number of destructive insects and snails that they devour. The following summary shows the number of harmful and beneficial organisms found in the 3 periods of the investigation :—

Total Summary of Food.

	Harmful organisms.	*Beneficial organisms.*	*No. of birds.*
January to December, 1912 ..	2,237	1,022	392
January to December, 1913 ..	2,961	451	271
January to May, 1914	710	79	85
	5,908	1,552	748

Mollusca found in Starlings.

1. The Banded Snail (*Helicella* (*Candidula*) *caperata*, Montagu).

This common snail, which now and then does a considerable amount of damage, seems to be one of the favourite mollusca of the starling. The only month in which it has not been found has been in September,

but in both years one must bear in mind that very few birds were received during that month.

The variety *bizonalis* was found now and again. In the birds examined no less than 300 specimens were found. In a single bird as many as 81 of these snails were found.

2. The Zoned Snail (*Helicella* (*Heliomanus*) *virgata*, Da Costa).

This occurred in a few birds, usually only as isolated specimens; 9 was the largest number found in a single starling. None was found in the birds from July to November. About 19 specimens only were noticed.

3. *Helicella* (*Thepa*) *cantiana*, Montagu.

A single specimen only found.

4. The Hairy Snail (*Hygromia* (*Fruticicola*) *hispida*, Linn.).

The Hairy or Bristly Snail is very often eaten by the starling. In the 748 birds examined 232 of these mollusca were found, including 3 of its varieties, *albocincta*, *subrufa*, and *depilata*. The Hairy Snail is found in hedges and old walls, under stones, logs of wood, and especially amongst herbage and moss in woods, fields and gardens. It undoubtedly does harm in gardens by eating the leaves of succulent plants, but the writers have not known of it as a field pest. It is somewhat rural in its habits and consequently not so harmful as the next. Nettles are its favourite food.

5. The Strawberry or Rufous Snail (*Hygromia* (*Fruticicola*) *rufescens*, Pennant).

This snail is also commonly found in the starling; 88 were found in the 748 birds, the majority in 1912-1913; 20 specimens was the greatest number found in any one bird. It is a common species in gardens, woods and hedges and is especially harmful to strawberries, violets and iris. A few specimens of the variety *albocincta* were found. The thrush, unlike the starling, breaks the shell of this snail and picks the mollusc out; the starling eats the shell also.

6. The White Snail Shell (*Vallonia pulchella*, Müller.)

This small snail also seems to be a common food of the starling. About 130 were found by us in the birds examined. It is said to inhabit only waste and uncultivated spots, but it may be found anywhere at the roots of grass, under stones and decaying wood, and in moss, especially in moist situations, but it is also to be found in dry places and on old walls. Mr. A. E. Craven says that this species is nearly always found under stones and never far from the ground; its food seems to be unknown.

7. The Transparent Glass Bubble (*Vitrina pellucida*, Müller.)

This small glass-like snail is commonly eaten by the starling. It is usually found in shady places in moss, under stones and logs of wood, and amongst dead leaves.

8. The Glassy Snail (*Vitrea* (*Polita*) *nitidula*, Drap.).

A few specimens only were found. It lives in watery places for preference, but also occurs in woods and banks under moss, herbage and dead leaves, and is sometimes found some inches deep in loose soil. This snail lives on decayed leaves and moss. It does not appear to be of any economic importance.

9. *Vitrea* (*Polita*) *radiatula*, Alder.

A few specimens were found.

10. *Vitrea* (*Polita*) *helvetica*, Blum.

Two specimens only were found.

11. The Radiated Snail Shell (*Pyramidula* (*gonyodiscus*) *rotundata*, Müller).

This shy species, which occurs in abundance in moss and amongst dead leaves, under stones, logs and the bark of trees, is often devoured by the starling; about 100 were found in the 748 birds.

12. *Jaminia muscerum*, Linn.

A single specimen only was found. This species occurs under dead leaves and stones, under the bark of trees, and on stones and rocks.

13. The Varnished Twist Shell (*Cochlicopa lubrica*, Müller).

This mollusc is fairly frequently eaten by starlings. About 130 specimens were found in the 748 examined. Of these 50 were found in February in 31 birds. It is an abundant species in fields, gardens, woods and hedgerows at the roots of grass, and amongst moss and dead leaves. It feeds on decayed vegetal and animal matter and will eat dead earthworms. It is of no economic importance as far as the writers know.

14. The Trident Shell (*Azeca tridens*, Pulteney).

A few of this species have been found in birds from Devon and elsewhere. It is found amongst herbage and in damp moss in woods.

15. The Pigmy Whirl Snail (*Vertigo* (*Aloca*) *pygmaea*, Drap.).

This very common species is occasionally eaten. It is found in marshes and on hills at the roots of grass and under stones and rubbish.

16. The Laminated Close Shell (*Clausilia* (*Marpessa*) *laminata*, Montagu).

Occasional specimens were found in the starlings. The species usually occurs on the trunks and at the roots of trees, especially beech and ash, but is also found in woods amongst dead leaves and on mossy rocks.

17. *Clausilia* (*Pirostoma*) *bidentata*, Ström.

A few specimens only were found.

18. The Wood Snail (*Helix nemoralis*, Linn.)

A single young specimen only was found.

19. The Periwinkle (*Littorina litoræa*, Linn.)

This common marine mollusc was found in a bird shot at Wye, together with seaweed and a small crab's leg. Probably on the coast the starling takes many marine shells.

20. Top Shell (*Trochus* sp.).

Several small Top Shells were found in a starling shot in May, 1911, near Wye, and others in a bird shot on Romney Marsh in 1899.

III.—THE CHAFFINCH (*Fringilla coelebs*, Linn.).

Owing to so little food being found in the chaffinches examined, the records given here must not be taken as giving any idea of the complete food of this bird.

It is difficult to say why so little is found in the chaffinch, unless it is that the greater part of the insect diet of this bird is of such a frail nature that it is soon destroyed. That this is the case is borne out by the following experience:—In July, 1910, some chaffinches were observed in the garden of one of the writers stripping the Black Fly (*Aphis rumicis*) off broad beans, and also eating Rose Aphides. It was easily seen where they had worked and cleared off the Aphis. The birds were shot and examined carefully next day; 2 whole aphides were found in one, 3 in another, and 6 wings only; the majority must thus have been so broken up as to be unidentifiable. One marked difference in the food of the birds examined in 1913, as distinct from 1912, was the greater amount of corn found. Corn found in the chaffinch differs from that found in the starling and rook, being nearly always in a fragmentary condition, while many seeds are shell-less, and so cannot be named.

From January to December, 1912, 286 birds were received; from January to December, 1913, 171 birds, and from January to May, 1914, 70 birds, making 527 in all. Of these, 34 birds were quite empty.

Specimens of chaffinches were received from 80 localities distributed over 23 counties in England, and from 1 district in Wales, 4 in Scotland, and 4 in Ireland.

FOOD OF THE CHAFFINCH.

The insect food found was very scanty; 69 Aphides were taken from the birds in 1912, including the Woolly Aphis, Apple Aphis (*Aphis pomi*), Plum Aphis (*A. prunì*), Currant Aphis (*Myzus ribis*), Bean Aphis (*A. rumicis*), Cabbage Aphis (*A. brassicæ*), and Rose Aphis (*Macrosiphum rosæ*), 54 in 1913, and 52 in 1914, also 20 Aphis ova in 1913, and 2 in 1914. A few Weevils seem to be eaten, including the Apple Blossom Weevil (*Anthonomus pomorum*); *Otiorhynchus* sp., *Barynotus* sp.; *Sitones* and *Apions*, but in very small numbers, only 28 in 1912, 5 in 1913, and 2 from January to May in 1914 being found.

A few Mussel Scales (*Lepidosaphæs ulmi*), Brown Scales (*Lecanium persicæ*) and a few Ash and Willow Scales (*Chionaspis salicis*), 31 specimens in all being found in the 493 birds which contained any food. Winter Moth (*Cheimatobia brumata*) larvæ are eaten to some extent, 26 being found in 1912, but none in 1913 and 1914. A few *Tortrix* larvæ also occurred in the first-named year. Thrips or Black Fly also seem to be taken, for 11 were found in 1912, and 8 in 1913. As many as 38 small *Bibio* larvæ were found in 1912, but none since. The few other insects were Earwigs (12); Wireworms and Click Beetles (10); Flea Beetles (4); Codling Moth maggots (3); Yellow Springtails (*Smynthurus luteus*) 2; 6 beneficial Carabid larvæ; 12 larvæ of Muscid type, and 5 Stratyomid larvæ (*Sargus* ?). Mollusca were only found in April, May and October, 1912, and consisted of a single specimen of each of the following: *Pyramidula rotundata*, *Hygromia hispida*, *H. rufescens*, *Helicella caperata*, and *Vallonia pulchella* (3 specimens).

The chief seeds devoured by the chaffinch were:—Charlock (*Sinapis arvensis*), (42–1912, 32–1913, 2–1914); Chickweed (*Stellaria media*) (58–1912, 27–1913, 10–1914); Knotgrass (*Polygonum aviculare*) (48–1912, 6–1914); Goosefoot (*Chenopodium*) (32–1912, 12–1913, 7–1914); Campion (*Silene Cucubalus*) (28–1912, 7–1913, 12–1914). The following also were found: Thistle (*Carduus lanceolatus*) 2; Wild Pea (*Lathyrus*) 3; Black Bindweed (*Polygonum Convolvulus*) 21; Speedwell (*Veronica*) 11; Spurrey (*Spergula arvensis*) 44; Groundsel 26; and a few Self Heal (*Prunella vulgaris*), Sheep's Sorrel (*Rumex Acetosella*), Milium (*Milium effusum*), Plantain (*Plantago* sp.), Ragwort (*Senecio* sp.), and Dovesfoot (*Geranium* sp.).

Corn seems to be taken all the year round, but less from May to September than during the remainder of the year; it is probably obtained largely from poultry food in farmyards, as well as from the stubble, from the stack yard and from standing corn. Its marked fragmentary nature in the chaffinch is very characteristic. Judging from the food found in these birds the chaffinch was mildly beneficial in 1912, but in 1913 it was slightly injurious for 5 months of the year; in January, June and November it was doing more good than harm.

NATURE OF FOOD, 1912.

The monthly record here cannot show anything definite as regards the food of the chaffinch as so many of the birds contained nothing much but grit and unidentifiable debris. The few objects found are given below:—

JANUARY.—The 5 birds received contained:—2 Rose Aphides (*Macrosiphum rosæ*); 22 Chickweed seeds (*Stellaria media*); 12 Knotgrass seeds (*Polygonum aviculare*); in 1 bird a grain of wheat was found; in another, 14 peas, and in a further bird, a piece of insect skin.

FEBRUARY.—Fifty-two birds in all were received, and these contained 59 harmful insects, as follows:—1 Wireworm (*Athous* sp.); 6 Raspberry Weevils (*Otiorhynchus picipes*); 35 Fever Fly larvæ (*Bibio hortulanus*); 3 Muscid larvæ (apparently *Stomoxys*); 1 wing of a Drosophilid Fly; 1 Earwig (*Forficula auricularia*); 8 Woolly Aphides (*Eriosoma lanigera*); 4 Mussel Scales (*Lepidosaphæs ulmi*). Also 1 Stratyomid larva; 1 Centipede (*Geophilus longicornis*)* and 6 small Carabid larvæ.* No fewer than 105 weed seeds were found, including:—6 Chickweed (*Stellaria media*); 6 Knotgrass (*Polygonum aviculare*); 24 Goosefoot (*Chenopodium* sp.); 2 Thistle (*Cnicus lanceolatus*); 18 Campion (*Silene Cucubalus*); 3 Wild Peas (*Lathyrus* sp.); 6 of Charlock (*Sinapis arvensis*); 18 Black Bindweed (*Polygonum Convolvulus*); 5 Speedwell (*Veronica* sp.); 1 Vetch (*Vicia* sp.); 1 Sheep's Sorrel (*Rumex Acetosella*); 3 Spurrey seeds (*Spergula arvensis*); 2 Milium (*Milium effusum*); 5 wild *Compositæ* and 5 wild *Cruciferæ* sp.? Also 2 Mustard Seeds (*Brassica alba*).*

Amongst grain there were found 35 grains and husks of wheat, 8 of barley, 3 of oats and 1 pea.

In 5 birds grass was found, stones in 13, and cabbage debris in 1.

MARCH.—The 25 birds received contained very little food. Only 9 insects were found, namely, 4 Click Beetles (2 *Athous* and 2 *Agriotes*); 2 Rose Aphides (*Macrosiphum rosæ*); 2 Ash and Willow Scales (*Chionaspis salicis*), and 1 Apple Blossom Weevil (*Anthonomus pomorum*).

Seventeen weed seeds were found:—4 Spurrey seeds (*Spergula arvensis*); 3 Charlock (*Sinapis arvensis*); 4 Chickweed (*Stellaria media*); 2 Self Heal (*Prunella vulgaris*); 1 Milium (*Milium effusum*); 1 Goosefoot (*Chenopodium* sp.?) and 2 Speedwell (*Veronica* sp.?).

Also 31 grains of wheat, 4 of barley, 3 of oats, and 1 of white Kaffir corn.

In 13 birds stones were found; vegetal matter in 3, and debris of small beetles in 5.

APRIL.—Eighty-two birds were received this month, and in these the following insects were found:—2 Wireworms; 1 Strawberry Weevil (*Anthonomus rubi*); 1 Muscid larva sp.?; 1 Stratyomid larva; 3 Fever Fly larvæ (*Bibio* sp.). Also 1 mollusc (*Pyramidula rotundata*).

Fifty-eight seeds occurred as follows:—12 Chickweed (*Stellaria media*); 6 Knotgrass (*Polygonum aviculare*); 10 Campion (*Silene Cucubalus*); 4 Goosefoot (*Chenopodium* sp.); 12 Charlock (*Sinapis arvensis*); 1 Vetch (*Vicia* sp. ?); 3 Speedwell (*Veronica* sp.); 1 Plantain (*Plantago lanceolatus*); 1 Dovesfoot (*Geranium molle*); 1 Black Bindweed (*Polygonum Convolvulus*); 1 Milium (*Milium effusum*); 3 wild *Cruciferæ*, and 3 Mustard (*Brassica alba*).* Also 2 grains of wheat.

In 79 birds stones and grit were found, grass in 6, leaves in 3, twigs in 1, beetle debris in 4, and decayed vegetal matter in 3.

MAY.—Sixty-two birds were examined. These contained very little animal or vegetal food.

The insects found only numbered 67, as follows :—23 Winter Moth larvæ (*Cheimatobia brumata*); 2 Tortrix larvæ (*Tortrix ribeana*); 12 other Tortrix larvæ sp. ?; 7 Geometer larval skins, probably Winter Moth; 7 Black Aphis (*Aphis rumicis*); 5 Muscid puparia and larvæ; 4 Cabbage Flea Beetles (*Phyllotreta cruciferæ*); 3 Currant Aphis (*Myzus ribis*); 1 Apple Blossom Weevil (*Anthonomus pomorum*); 1 Click Beetle (*Agriotes lineatus*); 2 small Carabid Beetles. Also 4 mollusca, 1 a young Hairy Snail (*Hygromia hispida*); 1 Strawberry Snail (*H. rufescens*); 1 Banded Snail (*Helicella caperata*) and 1 neutral *Vallonia pulchella*. The following 25 seeds were also found :—7 Chickweed (*Stellaria media*); 7 Spurrey (*Spergula arvensis*); 3 Goosefoot (*Chenopodium*); 1 Charlock (*Sinapis arvensis*); 3 Milium (*Milium effusum*); 3 Plantain (*Plantago lanceolatus*) and 1 White Mustard (*Brassica alba*).*

Stones were found in 46 birds, grass in 6, moss in 3, decayed vegetal matter in 4, and small fragments of beetles in 3.

JUNE.—Of the 19 birds received this month 12 had little or nothing in their crops.

The insects found in the remaining 7 birds were as follows :—3 Winter Moth larvæ (*Cheimatobia brumata*); remains of 4 Heart and Dart Moths (*Agrotis exclamationis*); 2 Apion Weevils (*Apion* sp. ?); 1 Apple Blossom Weevil (*Anthonomus pomorum*) larva; 2 Tortrix larvæ (*Tortrix* sp. ?); 1 Aphis (*Aphis* sp. ?); 1 Scale Insect (*Lecanium capreæ*), and 1 Earwig (*Forficula auricularia*), and 2 Beetle Mites (*Oribata lapidaria*).* Debris of beetles was found in 3 birds; stones, grit and pieces of brick in all; moss in 1, leaves in 1, and decayed vegetal matter in 1.

JULY.—Sixteen birds were examined. In 14 there was little or nothing found.

The insects were 3 Leaf Weevils (*Phyllobius oblongus*); 1 *Anthonomus* sp. ?; 2 Earwigs (*Forficula auricularia*); and 16 Apple Aphides (*Aphis kochii*).

Grass occurred in 6 birds; moss in 1; stones, cinders, grit and brick in 11.

AUGUST.—Only 7 birds were received this month; in these were found :—5 Apple Aphides (*Aphis kochii*); 12 Black Aphides (*Aphis rumicis*); 4 Black Fly (*Thrips* sp.); 14 Aphis wings (*Aphis* sp. ?); 1 Leaf Hopper (*Chlorita* sp. ?) and 6 grains of wheat. Grit and small stones were found in all, and in 1 bird some moss and leaves.

SEPTEMBER.—The 3 birds examined were all fairly full, and contained :—5 Apion Weevils sp. ?; 1 *Aphodius* ?; 9 Mussel Scales (*Lepidosaphæs ulmi*); 2 Woolly Aphides (*Eriosoma lanigera*); 4 larvæ of *Sciarinæ*; 6 claspers of Earwigs (*Forficula auricularia*); 2 Brown Scales (*Lecanium coryli*). Amongst seeds were 12 of Groundsel, 15 of Cress and 2 seeds of some wild Cruciferous plant.

OCTOBER.—During this month in 5 birds were found :—7 Black Fly (*Thrips* sp. ?) ; 3 Oak Aphides (*Callipterus quercus*) ; 1 Earwig (*Forficula auricularia*) ; and 2 neutral mollusca (*Vallonia pulchella*) and fragments of beetles in 1 bird. Grit was present in all 5 ; pieces of leaves in 2, and moss in 1.

NOVEMBER.—The 5 birds contained :—7 Pea and Bean Weevils (*Sitones lineata*) ; 3 Stratyomid larvæ ; 10 grains of wheat ; 10 Charlock seeds (*Brassica sinapis*). All 5 also had much grit in them.

DECEMBER.—In 3 birds examined this month no trace was found of any animal matter, but 10 Charlock seeds (*Sinapis arvensis*) ; 24 of Knotgrass (*Polygonum aviculare*) ; 7 of Chickweed (*Stellaria media*), and 11 of Groundsel, also 7 wheat grains and much vegetal debris.

THE CHAFFINCH.

Monthly Summary, 1912.

Month.	Harmful Insects.	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Plants.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain and Ben. Seeds.	Neutrals.	Number of Birds.
January ..	2	0	0	0	0	34	0	0	0	0	0	15	0	5
February	59	0	0	0	0	105	6	0	1	0	0	49	1	52
March ..	9	0	0	0	0	17	0	0	0	0	0	39	0	25
April ..	7	0	0	0	0	55	0	0	0	0	0	5	2	82
May ..	65	0	0	0	3	24	0	0	0	0	0	1	3	64
June ..	15	0	0	0	0	0	0	2	0	0	0	0	0	19
July ..	22	0	0	0	0	0	0	0	0	0	0	0	0	16
August ..	29	0	0	0	0	0	0	0	0	0	0	6	0	7
September	25	0	0	0	0	14	1	0	0	0	0	15	0	3
October	11	0	0	0	0	0	0	0	0	0	0	0	2	5
November	7	0	0	0	0	10	0	0	0	0	0	10	3	5
December	0	0	0	0	0	52	0	0	0	0	0	7	0	3
Total ..	251	0	0	0	3	311	7	2	1	0	0	147	11	286

SUMMARY, 1912.

From January to December, 1912, 286 chaffinches were found to have devoured 565 harmful organisms, including insects, mollusca and seeds, and 157 beneficial ones including insects, grain and seed, leaving a balance of 404 harmful organisms. The main food taken in January was composed of grain and weed seeds. From February to April it consisted of weed seeds and many insects, with some grain. In June, July, August, September and October it consisted mainly of insects, and then in November and December seed eating commenced again.

From these records the balance in favour of the chaffinch is decidedly marked. A question arises, however, in regard to weed seeds. How many are passed by the birds in their excrement and later germinate? This will be referred to later.

One noticeable feature has been that many of the birds contained nothing but grit and small stones; another the marked presence of the remains of such fragile insects as Aphides, showing that probably great numbers of these plant lice are devoured by this bird.

1913.

JANUARY.—The 11 birds received contained no insects or any animal matter. Of harmful seeds, there occurred 3 Knotgrass seeds (*Polygonum aviculare*); 10 Chickweed seeds (*Stellaria media*); 20 Charlock (*Sinapis arvensis*). The birds contained 7 wheat grains, 3 oats and 5 Indian corn; while grit, pebbles and brick were found in all.

FEBRUARY.—Twenty-one birds were examined, in which were found:—1 Charlock (*Sinapis arvensis*); 3 Knotgrass(*Polygonum aviculare*) and 4 Spurrey (*Spergula arvensis*) seeds; 49 grains of wheat, 1 bean, and beetle fragments in three birds. Also stones, grit and moss.

MARCH.—Thirty-seven birds examined; only 3 contained insects, of which 9 were found, including 2 Brown Scales (*Lecanium capreæ*); 2 *Aphis* sp.?; 2 young Leaf Hoppers (*Chlorita* sp.); 2 Wireworms, and 1 Mycetid larva (*Sciara*). Also the following seeds:—8 Spurrey (*Spergula arvensis*); 9 Charlock (*Sinapis arvensis*); 10 Chickweed (*Stellaria media*); 1 Speedwell (*Veronica* sp.); 3 Sheep's Sorrel (*Rumex Acetosella*); 5 Self Heal (*Prunella vulgaris*); 12 Goosefoot (*Chenopodium* sp.); 1 Vetch (*Vicia* sp.); 7 Campion (*Silene Cucubalus*); 1 Millet (*Milium effusum*); 6 mustard*; 127 wheat; 3 barley; 5 oats; 2 peas. Bud scales, possibly of Plum, occurred in 1; much grit was found in all.

APRIL.—Thirty birds examined. These contained only 14 insects, viz., 7 Plum Aphis (*Aphis prumi*); 4 Apple Aphis (*Aphis mali*); 2 Black Fly (*Thrips* sp.), and 1 Midge (*Chironomus*); 13 Spurrey (*Spergula arvensis*) seeds, and 3 Chickweed (*Stellaria media*) and 47 grains of wheat, mostly fragmentary. Also grit and moss.

MAY.—The 15 birds examined contained:—1 Aphis (*Aphis pomi* ?); 2 Black Fly (*Thrips* sp.?), and 1 Staphylinid beetle*; 2 Chickweed (*Stellaria media*) seeds. Two grains of wheat and 2 oats.

JUNE.—Four birds were examined. The contents consisted of 5 Aphides (2 *Aphis mali*, 2 *Macrosiphum pisi*, 1 *Eriosoma lanigera*); 3 Mussel Scale (*Lepidosaphæs ulmi*); 1 Apple Blossom Weevil (*Anthonomus pomorum*); 2 Charlock seeds and 3 grains of corn.

JULY.—The 8 birds examined contained:—1 Black Aphis (*Aphis rumicis*); 2 Chickweed (*Stellaria media*) seeds and 3 grains of wheat. Beetle debris in 2 birds and cabbage debris in 2 birds.

AUGUST.—In the only 2 birds sent in, both with very nearly empty crops, were 5 grains of wheat in fragments and grit.

SEPTEMBER.—The 5 birds examined, apart from moss which was found in 3, contained nothing but grit.

OCTOBER.—Twenty-two birds in all received. They contained 2 Barynotus Weevils (*Barynotus obscurus*); 1 Apple Blossom Weevil (*Anthonomus pomorum*) and the body of a small Carabid; 2 seeds

of Sheep's Sorrel (*Rumex Acetosella*) and 1 Plantain (*Plantago* sp. ?). Wheat, 59 grains; maize, 2; beans, 2. Grit in all but 1, grass in 2.

NOVEMBER.—Five birds were received. The contents were :—10 Cabbage Aphid (*Aphis brassicæ*); 1 Apple Blossom Weevil (*Anthonomus pomorum*); 4 Black Flies (*Thrips* sp. ?); 7 Brown Scales (*Lecanium persicæ*); 1 Rove Beetle (*Staphylinidæ*)*; 1 Muscid larva*; 11 Beetle Mites (*Oribatidae*)*; 11 Dock seeds (*Rumex* sp ?); 4 cabbage seeds*; 6 grains of wheat and 1 of barley.

Moss, grit and vegetal matter occurred in all.

DECEMBER.—Eleven birds were received, of which 2 were empty. In the remainder were found :—2 Woolly Aphis (*Eriosoma lanigera*); 3 Earwigs (*Forficula auricularia*); 1 Codling Maggot (*Carpocapsa pomonella*) and 20 Aphis ova. Amongst seeds :—1 Sheep's Sorrel (*Rumex Acetosella*); 4 Ragwort (*Senecio* sp.); 4 Pine Seeds (*Pinus* sp.)*; and 4 Canary Seeds.* There were also found 33 grains of wheat. In 1 bird a beetle leg, and some moss, grit, leaves, and grass in others.

THE CHAFFINCH.

Monthly Summary, 1913.

Month.	Harmful Insects.	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Seeds.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain.	Neutrals.	Number of Birds.
January..	0	0	0	0	0	33	0	0	0	0	0	15	0	11
February	0	0	0	0	0	8	0	0	0	0	0	50	0	21
March ..	9	0	0	0	0	57	0	0	0	0	0	143	0	37
April ..	13	0	0	0	0	16	0	0	0	0	0	47	1	30
May ..	3	0	0	0	0	2	1	0	0	0	0	4	0	15
June ..	9	0	0	0	0	2	0	0	0	0	0	3	0	4
July ..	1	0	0	0	0	2	0	0	0	0	0	3	0	8
August ..	0	0	0	0	0	0	0	0	0	0	0	5	0	2
September	0	0	0	0	0	0	0	0	0	0	0	0	0	5
October	3	0	0	0	0	3	0	0	0	0	0	63	1	22
November	22	0	0	0	0	11	2	11	0	0	0	11	0	5
December	26	0	0	0	0	5	0	0	0	0	0	41	0	11
Total ..	86	0	0	0	0	139	3	11	0	0	0	385	2	171

SUMMARY, 1913.

The results obtained this year differed in some respects from those of 1912. The 171 birds examined had eaten proportionately much more grain, some grain being found in all months, except in September, when no trace of cereals could be found. It must be mentioned, however, that in

September little or nothing was to be seen in the 5 birds examined except moss and grit.

In February and March the chaffinch seemed to be doing more harm than good, also again in August and October. In January, June and November more good than harm was being done, whilst in May, July and December the accounts about balanced.

The number of insects found in these birds—less than one per bird—can hardly, however, represent the true insect food of the chaffinch.

Harmful seeds occurred at the rate of only 1 per bird, whilst grain was found at the rate of over 2 per bird. The major part of the contents of the birds' crops consisted of grit, small stones, and decayed vegetal matter.

From this survey it may be judged that the chaffinch was slightly more harmful than beneficial in 1913, but during only 4 months of the year.

1914.

JANUARY.—Four birds examined. These contained 28 grains of wheat only and some grit.

FEBRUARY.—Twenty-eight birds contained :—1 Mussel Scale (*Lepidosaphæs ulmi*) and 1 Spider.* Also the following Weed seeds :—5 Sheep's Sorrel (*Rumex Acetosella*) ; 11 Campion (*Silene Cucubalus*) ; 2 Charlock (*Sinapis arvensis*) ; 5 Goosefoot (*Chenopodium* sp.) ; 1 Chickweed (*Stellaria media*) ; 1 Black Bindweed (*Polygonum Convolvulus*) ; 2 Self Heal (*Prunella vulgaris*) ; 3 Speedwell (*Veronica* sp.). One cabbage seed* ; 1 of Brome grass* ; 59 grains of wheat ; 2 peas ; 1 radish seed ; beetle debris in 5 ; cabbage debris in 1.

MARCH.—Fourteen birds. The only insect food found was some beetle debris in 1 bird, which could not be identified as it was too triturated.

Amongst weed seeds was 1 Spurrey seed (*Spergula arvensis*) ; 1 Campion (*Silene Cucubalus*) ; 1 Goosefoot (*Chenopodium*) ; 1 Black Bindweed (*Polygonum Convolvulus*) ; and the seeds of 4 wild *Cruciferæ* ?

Wheat, 71 grains. Grass in 2 birds, and vegetal debris in 1.

APRIL.—Five birds. The insects found were :—2 Woolly Aphis (*Eriosoma lanigera*) ; 2 Aphis ova ; 2 pupæ of the Codling Moth (*Carpocapsa pomonella*) ; 2 small Muscid larvæ ; also 5 Chickweed seeds (*Stellaria media*) ; 9 grains of wheat and 1 pea. Beetle debris was found in 2 birds.

MAY.—Nineteen birds examined. The insects found were :—2 Apion Weevils (*Apion* sp. ?) ; 1 Earwig (*Forficula auricularia*) ; 1 Apple Blossom Weevil (*Anthonomus pomorum*) ; 1 Sciara Midge larva (*Sciara* sp. ?) ; 50 Plum Aphides (*Aphis pruni*) ; 1 Rove Beetle body (*Staphylinid*)* ; 1 small Muscid larva ; 2 Yellow Springtails (*Smynthurus luteus*). Also the following weed seeds :—4 Chickweed (*Stellaria media*) ; 4 Spurrey (*Spergula arvensis*) ; 1 Milium (*Milium effusum*) ; 1 Goosefoot (*Chenopodium* sp. ?) ; 3 Plantain (*Plantago* sp. ?). Grains of wheat, 12. Stone, grit in all. Grass in 1, and decayed vegetal matter in 3.

THE CHAFFINCH.
Monthly Summary, 1914.

Month.	Harmful Insects.	Harmful Arachnids.	Harmful Myriapoda.	Harmful Crustacea.	Harmful Mollusca.	Harmful Seeds.	Beneficial Insects.	Beneficial Arachnids.	Beneficial Myriapoda.	Beneficial Crustacea.	Beneficial Mollusca.	Grain.	Neutrals.	Number of Birds.
January ..	0	0	0	0	0	0	0	0	0	0	0	28	0	4
February	1	0	0	0	0	30	0	1	0	0	0	64	0	28
March ..	0	0	0	0	0	8	0	0	0	0	0	71	0	14
April ..	6	0	0	0	0	5	0	0	0	0	0	10	2	5
May ..	57	0	0	0	0	13	1	0	0	0	0	12	1	19
Total ..	64	0	0	0	0	56	1	1	0	0	0	185	3	70

SUMMARY. 1914.

Birds were examined only from January to May. From January to March the birds examined appeared to have been more harmful than beneficial. In April the good and harm done were about equal, and in May the birds were doing much more good than harm.

THE CHAFFINCH.
Chief Insects Eaten.
1912.

Month	Aphides and Leaf Hoppers.	Earwigs.	Coccids.	Weevils.	Winter Moth.	Tortrix.	Thrips.	No. of Birds.
January ..	2	0	0	0	0	0	0	5
February ..	8	1	4	6	0	0	0	52
March	2	0	2	1	0	0	0	25
April	0	0	0	1	0	0	0	82
May	10	0	0	1	23	14	0	64
June	1	1	1	3	3	2	0	19
July	16	2	0	4	0	0	0	16
August ..	25	0	0	0	0	0	4	7
September ..	2	3	11	5	0	0	0	3
October ..	3	1	0	0	0	0	7	5
November ..	0	0	0	7	0	0	0	5
December ..	0	0	0	0	0	0	0	3
Total ..	69	8	18	28	26	16	11	286

1913.

Month.	Aphides and Leaf Hoppers.	Earwigs.	Coccids.	Weevils.	Winter Moth.	Tortrix.	Thrips.	No. of Birds.
January ..	0	0	0	0	0	0	0	11
February ..	0	0	0	0	0	0	0	21
March	4	0	2	0	0	0	0	37
April	11	0	0	0	0	0	2	30
May	1	0	0	0	0	0	2	15
June	5	0	3	1	0	0	0	4
July	1	0	0	0	0	0	0	8
August ..	0	0	0	0	0	0	0	2
September ..	0	0	0	0	0	0	0	5
October ..	0	0	0	3	0	0	0	22
November ..	10	0	7	1	0	0	4	5
December ..	22	3	0	0	0	0	0	11
Total ..	54	3	12	5	0	0	8	171

Grain, Harmful Seeds and Mollusca.

1912.

Month.	Grain and useful Seed.	Harmful Seeds.	Harmful Mollusca.	No. of Birds.
January	15	34	0	5
February	49	105	0	52
March	39	17	0	25
April	5	55	0	82
May	1	24	3	64
June	0	0	0	19
July	0	0	0	16
August	6	0	0	7
September	15*	14	0	3
October	0	0	0	5
November	10	10	0	5
December	7	52	0	3
Total	147	311	3	286

* All Cress seed.

1913.

Month	Grain and useful Seed.	Harmful Seeds.	Harmful Mollusca.	No. of Birds.
January	15	33	0	11
February	50	8	0	21
March	143*	57	0	37
April	47	16	0	30
May	4	2	0	15
June	3	2	0	4
July	3	2	0	8
August	5	0	0	2
September	0	0	0	5
October	63	3	0	22
November	11†	11	0	5
December	41‡	5	0	11
Total	385	139	0	171

General Summary and Conclusions.

The chaffinch seemed to be mainly insectivorous from May to October in 1912, in 1913 only so in June and November, and in 1914 in May; for the other months the insect food was very small. In 1912 weed seeds were largely eaten in January, September and December and to some extent in February and November. In 1913 the most seeds were eaten in January and November and a certain amount in February, March, April, October and December. In 1914 only a few were eaten during the five months.

The birds seemed to eat a considerable amount of grain in January and September and some in February, March, April, August, November and December of 1912. In 1913 most of the grain was eaten from January to April and again in August, October, November and December. In 1914 still more was eaten in January, and a considerable amount from February to April.

It is extremely difficult to form any judgment regarding the economic status of the chaffinch, but from the food contents

* Including 6 Mustard Seeds. † Including 4 Cabbage Seeds.
‡ Including 4 Pine and 4 Canary Seeds.

found the writers are inclined to look upon it as neutral. The question largely depends upon how many of the seeds that they have eaten germinate after expulsion. The part the chaffinch plays as an Aphis destroyer is not accurately shown by an examination of the crops, but the following summary gives an idea of the relative harm and good done by the birds examined :—

Total Summary of Food.

	Harmful Organisms.	*Beneficial Organisms.*	*No. of Birds.*
January to December, 1912 . .	565	157	286
January to December, 1913 . .	225	399	171
January to May, 1914 . .	120	187	70
	910	743	527

REPORT ON THE FOOD FOUND IN THE ROOK, STARLING AND CHAFFINCH.

H. S. LEIGH, M.Sc.,
Manchester University.

In the autumn of 1908 a Committee was formed to investigate the feeding habits of certain birds, the economic position of which affects agricultural science.

It was decided that attention should at first be concentrated on three species, viz., rook, starling and chaffinch. For some considerable time there has been much doubt and discussion regarding the economic status of these three birds, and it was felt that a properly organised enquiry should be conducted with a view to deciding whether all or any of the three species under consideration are beneficial or injurious to agricultural and horticultural interests in the British Isles.

The following paper is a brief account of the work which has been done on the feeding habits of the rook, starling and chaffinch up to the present time. The work has been carried on in the Zoological Department of the University of Manchester.

It has not yet been possible to publish a complete and detailed tabulation of the crop and gizzard contents. Complete tabulated statements of the food of the rook, starling and chaffinch have been made, and other elaborate tables and deductions are in course of preparation ; these particulars will be incorporated in a fuller account which it is hoped may be published in the near future.

SCOPE AND METHOD OF ENQUIRY.

The total number of rooks received up to May, 1915, was 332, the number of starlings 662, and of chaffinches 490. The whole of the crop contents of these (1,484) specimens received have (with the exception of some of the chaffinches) been identified and recorded, but many of the particulars now stated concern the results obtained from the examination of 1,061 specimens, viz., 218 rooks, 486 starlings, and 357 chaffinches.

It was requested by the Committee that each correspondent should, as far as possible, send in five specimens each month together with a "form of particulars."* Although the number of birds received has fallen much below that which it was hoped to obtain, some of the correspondents have sent in very many specimens and it may be said that most of them have rendered valuable assistance to the investigation by returning birds from time to time.

The area covered by this investigation is fairly wide and of a varied character; rooks have been received from 63 localities, starlings from 97 and chaffinches from 74; these localities are situated in the following counties:—Aberdeen, Anglesey, Bedfordshire, Buckinghamshire, Carmarthenshire, Cheshire, Cumberland, Denbighshire, Derbyshire, Devonshire, County of Dublin, Dumfriesshire, Durham, County of Edinburgh, Essex, Fifeshire, Hampshire, Herefordshire, Huntingdonshire, Isle of Wight, Lancashire, Lincolnshire, Merionethshire, Midlothian, Monmouthshire, Norfolkshire, Northamptonshire Oxfordshire, Pembrokeshire, Radnorshire, Shropshire, Somersetshire, Staffordshire, Warwickshire, Westmorland, Worcestershire, and Yorkshire.

The supply of birds from the counties enumerated was insufficient, both in regard to total numbers and regularity, to base a really correct estimate of the birds' economic position thereon. To take an example of the rook: from the county of Denbigh (which includes four localities, two near Wrexham and two near Llangollen) a fairly large number of birds were received during the months January to June, inclusive, and also August, but very few were received during September and December and none during July and November. Again, whilst about 52 starlings and 48 chaffinches were received from Denbighshire, only one specimen of each species was received from Westmorland. The above principle is of course also applicable to other counties.

* This form is filled in by the correspondent, and contains all the particulars of the conditions under which the bird was shot.

Nevertheless it is hoped that the result of this detailed investigation, in which particularly the insect portions of the food and the seeds of weeds were carefully identified, will be regarded as a considerable advance in our definite knowledge of the food of these birds.

I.—FOOD OF THE ROOK.

Animal Food.

(*a*) *Insects.*—The greater portion of the animal food consisted of insects, which were recorded in 105 cases.

Coleoptera.—In 80 cases beetles or their larvæ were present; "wireworms" or their adults being found 19 times.

Lepidoptera occurred in 14 cases, larvæ being found in 12 instances and scales and other remains of adults twice.

Diptera occurred 56 times, all stages being represented, but the larval form (leather-jackets) of the crane-flies was predominant; they were found in 32 cases.

Hymenoptera were found on 6 occasions and included 2 wasps, 1 ant and 1 ichneumon.

Orthoptera occurred 4 times; earwigs were found 4 times and a grasshopper once.

(*b*) *Mollusca.*—In 9 cases molluscs were found, including 2 slugs.

(*c*) *Vermes.*—Remains of earthworms, including their egg capsules, occurred in 46 instances; remains of another Oligochaet once; in 3 gizzards there were Nematode worms.

(*d*) *Myriapoda.*—Centipedes and millepedes occurred 5 times.

(*e*) *Arachnida.*—Spiders occurred twice, and "harvestman" (*Phalangid*) once.

(*f*) *Other Animal Matter.*—In 1 gizzard the remains of a shrew were found and in another case the bones of a frog, and in 5 cases portions of egg-shell (generally fowl's) were found. Unrecognisable animal matter occurred once.

Vegetable Food.

Grain.—The greater part of the vegetable food recorded consisted of grain, which was found in 157 cases. Oats were in greatest abundance and were recorded in 98 instances; barley occurred 55 times, wheat 28 times, and maize was found in 11 cases.

Seeds other than grain.—Seeds occurred in only 13 cases; in 6 there were portions of bean; seeds of ash were present once; seed of *Ruppia* sp. once; seed of charlock once; a single instance of a ranunculaceous weed seed; 1 case of a single holly and cotoneaster (?) seed in the same gizzard; and there were 2 cases of seed the identification of which was impossible.

Fruit.—Remains of fruit, almost entirely in the form of acorns, were found in 33 cases; portions of acorns occurred in 31 instances and walnut once. In 1 gizzard part of a small unripe fruit was found.

Roots.—Roots occurred in 63 gizzards. Potato was in greatest abundance, it having been found in 43 cases; turnip occurred 7 times; mangold, twice; grass roots twice; a root (probably wild carrot) once; and earthnut once. In 6 gizzards unrecognisable roots were present.

Herbage.—Pieces of grass occurred 29 times, but in some cases there was only a blade or two; clover leaves were found once.

Miscellaneous Vegetable Matter.—Vegetable matter, which could not be identified, occurred in 27 cases.

Miscellaneous Food.

In 15 instances meat and carrion occurred, and kitchen refuse was found in 9 gizzards; this included small pieces of bread 3 times, potato twice, portions of bone 3 times, and tea leaves once; unrecognisable miscellaneous food occurred once.

SUMMARY OF RESULTS.

Summarising the contents of the 209 rooks containing food, grain was in greatest abundance, it having been found in 73 per cent. of the gizzards, and in 57 cases in which it occurred it formed 70 to 80 per cent. of the food contents. Roots of value to the farmer (*i.e.*, potatoes, mangolds, etc.) were found in 20 per cent. of the birds. Injurious insects occurred in 36 per cent. of the gizzards, the percentage for "leather-jackets" (*Tipulidæ*) being 15, and 9 for "wireworms" or their imagos (*Elateridæ*). At least 2 instances in this enquiry show in a very pronounced manner the large number of injurious insects which may be taken by a single rook in the course of a short time. Thus in 1 gizzard from Cumberland 95 whole Tipulid larvæ ("leather-jackets") were found, and as many as 103 Elater larvæ ("wireworms") were present in another; it is, therefore, obvious that these birds were rendering valuable service to the farmer.

This investigation has shown that the percentage of animal food taken from April to September is large and also that it is made up mainly of injurious insects; so that for six months rooks appear to take a large quantity of injurious insects as food. On the other hand, we have to record a large quantity of grain in the rooks' diet; for 9 months of the year (from September to May inclusive) the percentage of grain is very high, and only falls to a really low level in June, July and August.

It would, however, be most unwise to rely entirely upon statistics obtained from stomach dissections and to say that, because the figures show a large percentage of grain, the rook is doing a great amount of damage to the crops. It has been frequently observed that rooks, when feeding upon grain in September and October, are not doing any damage to the crops but are merely taking the grain which has been dropped during harvesting operations. Reliable observational evidence in addition to dissections is, therefore, of much importance in an investigation of this nature. The rook appears to feed largely upon insects in all stages during certain periods of the year, but it is not very particular as to its diet, and, if the

supply of insects falls short (as it does during the winter months), a good deal of grain and other food is taken.

II.—FOOD OF THE STARLING.

Animal Food.

(*a*) *Insects.*—The greater portion of the animal food consisted of insects, which were recorded in 444 cases.

Coleoptera.—In 363 cases beetles or their larvæ were present, "weevils" being found in 260 instances, and in 130 cases "wireworms" or their adults were present.

Lepidoptera were found in 121 cases, and consisted almost entirely of larvæ (caterpillars), particularly those of the Large Yellow Underwing Moth (*Triphæna pronuba*); pupæ occurred twice.

Diptera occurred 316 times, all stages being represented, but the larval form (leather-jackets) of the crane-flies (*Tipulidæ*) were predominant, being present in 213 instances.

Hymenoptera occurred 35 times; ants being present in 29 cases (the number of specimens was 102); 1 bee was found and 2 pupæ of saw-fly occurred in one crop.

Orthoptera occurred 32 times, and of these earwigs were found 31 times and a young grasshopper once.

Hemiptera occurred 4 times; Cercopidæ "frog-hoppers" occurred 3 times and *Aphidæ* once (1 green fly).

(*b*) *Mollusca.*—The total number of cases in which Molluscs have occurred is 328; this includes slugs 4 times (probably *Agriolimax*).

(*c*) *Arachnida.*—The total number of cases in which Arachnids have occurred is 83; these were all spiders, 1 of which was a red spider (*Tetranychus* sp.); mites occurred once.

(*d*) *Vermes.*—Remains of earthworms (including *setæ* 5 times) occurred in 6 instances; earth-worm cocoons were found in 22 cases; Nematode worms occurred 6 times.

(*e*) *Myriapoda* occurred 33 times; centipedes were found in 6 cases and millepedes in 25.

(*f*) *Crustacea, Amphipods.—Gammarus pulex* occurred twice; wood-lice were found twice.

(*g*) *Other Animal Matter.*—In 6 cases bones (unrecognisable) were found and in 5 instances pieces of egg-shell (generally fowl's) were present.

Vegetable Food.

Grain.—The greater part of the vegetable food consisted of grain, which was found in 161 cases. As in the case of the rook, oats were in greatest abundance and were recorded in 66 instances; wheat occurred 41 times, barley 40 times, maize twice, and buckwheat and black-oats each once.

Seeds other than Grain.—Seeds occurred in 78 cases; these included such seeds as the following:—Ranunculus, Charlock (*Sinapis arvensis*), Clover (*Trifolium* sp.), Chickweed (*Stellaria media*), Blackberry (*Rubus fructicosus*), Elder (*Sambucus nigra*), Dock (*Rumex* sp.), Knotgrass (*Polygonum aviculare*), Spurrey (*Spergula arvensis*), and grass seeds (*Gramineæ*).

Fruit.—Remains of fruit, consisting chiefly of the pulp and skins of elder berries, were found in 14 cases; fragments of crab-apple occurred

once and pieces of pear once; berries of Black Bryony (*Tamus communis*) once, and in one case an unidentifiable fleshy fruit was found.

Roots.—Roots occurred 19 times; roots of grasses were in greatest abundance, having been found in 5 cases; potato occurred 3 times, rootlets of wheat twice and unidentifiable roots 9 times.

Herbage.—Pieces of grass occurred 78 times, young Onion plants were found once; flower heads of Daisy 3 times; flower-heads of Coltsfoot once; portions of flower-heads of Dandelion occurred once; flower-heads of Yellow Goat's-beard (*Tragopogon pratensis*) once; leaves of Clover were found once, and other leaves 30 times; moss was found in 12 cases.

Miscellaneous Vegetable Matter.—Vegetable matter which could not be identified occurred in 152 cases.

Miscellaneous Food.

In 5 instances meat and carrion occurred; kitchen refuse was found in 17 cases, and this included pieces of bread 3 times, potato twice, pieces of bone 6 times, tea-leaves 4 times, pieces of egg shell 5 times, fat once, meal once.

One jaw bone of a shrew was found; feathers occurred 13 times, bits of rag 5 times; bits of straw 3 times and linen thread once.

SUMMARY OF RESULTS.

Summarising the contents of the 486 starlings examined, insects were in greatest abundance, having been found in 91 per cent. of the birds examined and in 249 cases in which they occurred they formed about 75 per cent. of the food contents. Injurious insects occurred in 365 cases; these consisted very largely of weevils and leather-jackets, the former being present in 260 cases and the latter in 213 cases. Fully-grown caterpillars of the large yellow underwing moth, and larvæ of the click beetle (wireworms) were present in very many cases. Earwigs were also found in many of the birds examined. As many as 197 leather-jackets were found in 1 crop and at least 4 crops contained more than 150 in each; it is plain therefore that these birds were rendering valuable service to the farmer.

This enquiry has shown that the percentage of animal food taken by the starling is very large and also that this is made up almost entirely of insects, the majority of which are most injurious. On the other hand, we have to record a fair proportion of grain in the starling's diet, though this is not by any means so large as in the case of the rook. As with the rook, however, it would be most unsafe to say that, because the figures show a rather high percentage of grain at certain times of the year, the starling was doing damage to the extent indicated. Even if this were the case at certain seasons, however, the harm thus done to the farmer would probably be

more than compensated for by the large quantity of injurious insects taken at other times of the year.

The records of this investigation so far show that the starling, if not too abundant, must certainly be regarded as a friend of the agriculturist.

III.—FOOD OF THE CHAFFINCH.

Animal Food.

(*a*) *Insects.*—Practically the whole of the animal food consisted of insects, which were recorded 128 times.

Coleoptera.—In 79 instances beetles or their larvæ were present and these included *Rhyncophora* (weevils) 31 times and remains of *Chrysomelidæ* 7 times.

Lepidoptera occurred in 10 cases, and these included remains of imagines 3 times.

Diptera occurred 34 times; no larvæ of the crane-fly (leather-jackets) were found, but an adult crane fly (*Tipulid*) containing 15 eggs occurred once, and an adult crane-fly without eggs once.

Hymenoptera occurred twice.

Hemiptera: Aphids (plant lice) occurred twice.

(*b*) *Arachnida.*—A spider was found once; 3 spider embryos (probably) occurred once, and fragments of mites once.

(*c*) *Vermes.*—An earthworm cocoon was found once.

(*d*) *Other Animal Matter.*—Feathers occurred once.

Vegetable Food.

Seeds.—The greater part of the vegetable food recorded consisted of seeds of weeds. They were found in 242 cases; this number includes amongst others such well-known species as Dock, Chickweed, and Knotgrass. Seeds of Dock (*Rumex*) occurred 34 times, Chickweed (*Stellaria media*) was found 67 times, Knotgrass (*Polygonum*) 63 times, and Timothy grass (*Phleum pratense*) 32 times.

Grain occurred 146 times. Wheat was in greatest abundance, having been found 63 times; oats occurred 33 times, maize twice and barley twice.

Seeds of value, other than Grain.—Seeds of value to the farmer occurred 13 times; these included clovers (*Trifolium*) 11 times, remains of Crucifer (probably Turnip) once, and Garden Pea (*Pisum*) once.

Seeds of doubtful economic importance occurred once.

Seeds (*unidentifiable*) occurred twice.

Herbage.—Moss, leaves and fragments of a leaf were found once, Callitriche leaves occurred twice, young floret (probably *Carduus*) occurred once, triturated cotyledons of (probably) Crucifer occurred 5 times, a leaf of *Vaccinium Myrtillus* was found once, Sphagnum fragments occurred 3 times, 2 leaves of (probably) *Montia fontana* were found once, and flower anthers occurred three times.

Fruit.—Remains of fruit (disintegrated) occurred once.

Miscellaneous Vegetable Matter occurred 46 times.

Miscellaneous Matter occurred 131 times.

SUMMARY OF RESULTS.

Summarising the contents of the 357 chaffinches examined, weed seeds were in greatest abundance, having been found in

67 per cent. of the crops, and in 86 cases in which they occurred they formed 95 per cent. of the food contents. Injurious insects occurred in 14 per cent. of the crops, the percentage of "weevils" (*Rhyncophora*) being 9. Many instances in this enquiry show that the chaffinch takes large quantities of some of the most troublesome weed seeds, such as Chickweed, Dock, Hawkweed, Knotgrass; Chickweed especially being taken in large quantities. Grain was found in 41 per cent. of the birds; but it appeared in most cases to be taken from manure or ricks in farm yards and not from the cultivated land, so that the bird was really doing little or no damage to the farmer. Seeds of value to the farmer other than grain (such as clover, turnip) were found in only 3 per cent. of the birds; this number is surprisingly small in view of the general impression prevailing as to the destructive habits of the chaffinch.

The Journal

OF THE

BOARD OF AGRICULTURE

(PRICE 4d., Post Free)

IS

AN OFFICIAL AGRICULTURAL JOURNAL PUBLISHED ON THE 15TH OF EACH MONTH

BY THE

BOARD OF AGRICULTURE AND FISHERIES,

Whitehall Place, London, S.W.,

FOR THE BENEFIT OF AGRICULTURISTS.

CONTENTS.

The following are some of the principal articles which have appeared in recent numbers :—

March, 1916.

Accumulated Fertility in Grass Land in consequence of Phosphatic Manuring: Second Report on Experiments (*illustrated*).
The Growing of Sugar Beet.
Farm Valuations for Book-keeping Purposes.
A New Method for the Destruction of Bacteria in Large Volumes of Milk by means of Electricity (*illustrated*).
Destruction of Rats in East Lothian.
Summer Sprays against American Gooseberry Mildew.
Silage as Food for Stock.

April, 1916.

The French Agricultural Labour Problem.
Economy in Food.
The Washing Out of Nitrate from Arable Soil during the Past Winter.
Fish Meal as Food for Pigs.
The Sale of Home-Grown Wool.
Two New Seedling Hops of Commercial Promise (*illustrated*).
Co-operative Farm Implement Societies (*illustrated*).
Mangolds or Swede Turnips for Dairy Cows.

At the present time an endeavour is being made to publish matter of definite interest and value under War conditions. Summaries of Agricultural Experiments, Notes on Agricultural Co-operation and Small Holdings, and Market Prices appear regularly. The JOURNAL is usually illustrated.

Farmers, land agents, landowners and others are asked by the Board of Agriculture and Fisheries to support their JOURNAL, which is definitely published for the benefit of all classes of agriculturists, and is accordingly sold at a very low price (see below). The JOURNAL should be bound and placed in the bookshelf of every agriculturist for reference purposes; it will answer a large number of questions which are put to the Board every month.

Three Months, 1s.; Six Months, 2s.; Twelve Months, 4s. (Post free).

PAT. JAN. 21, 1908